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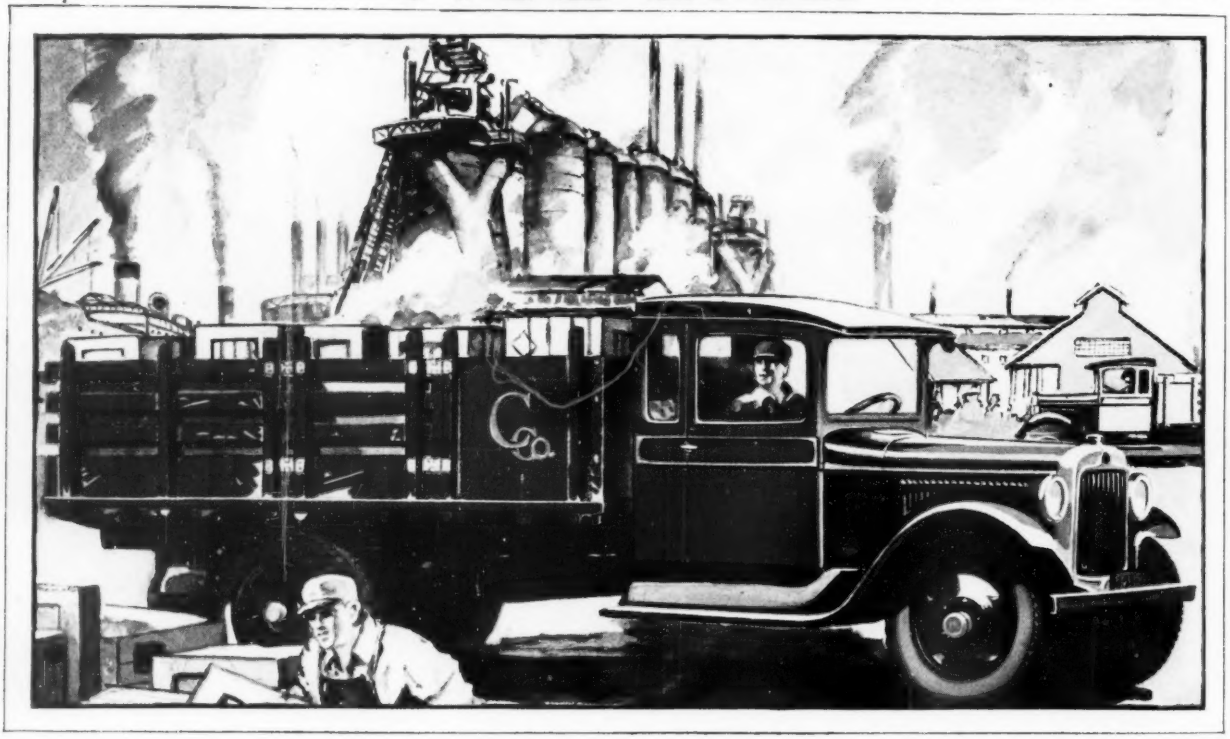
CHRYSLER MOTORS PRODUCT



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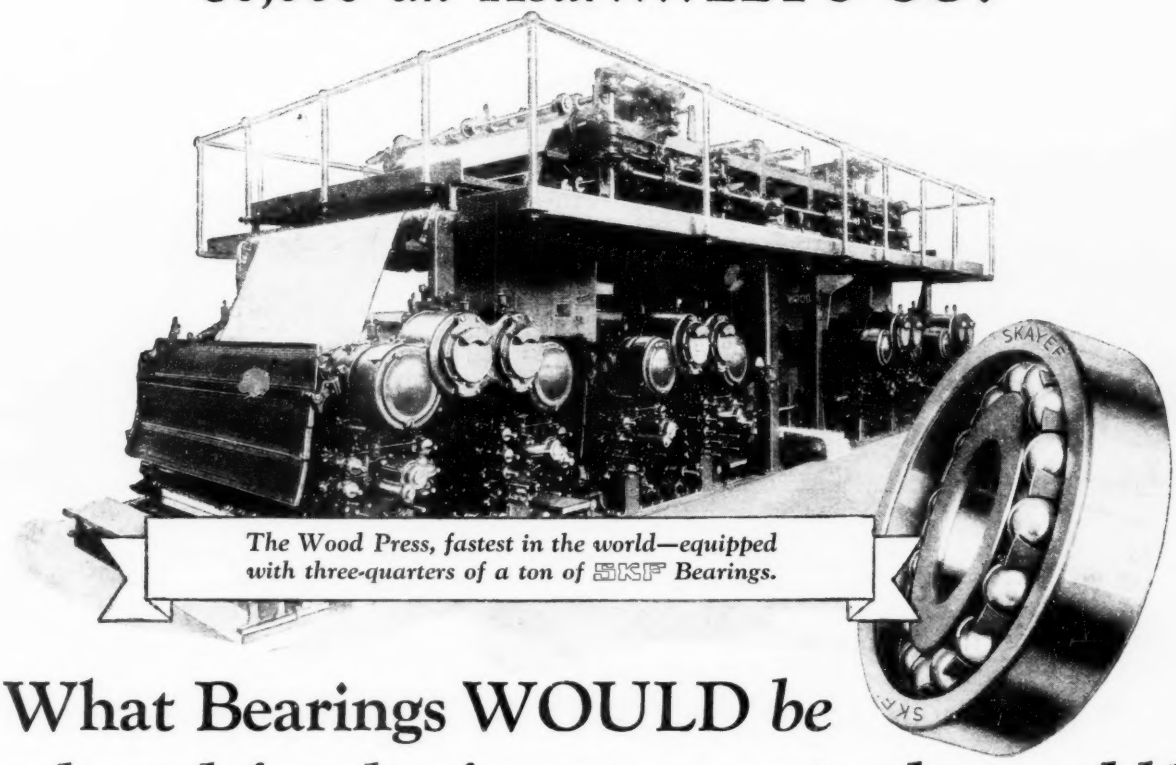

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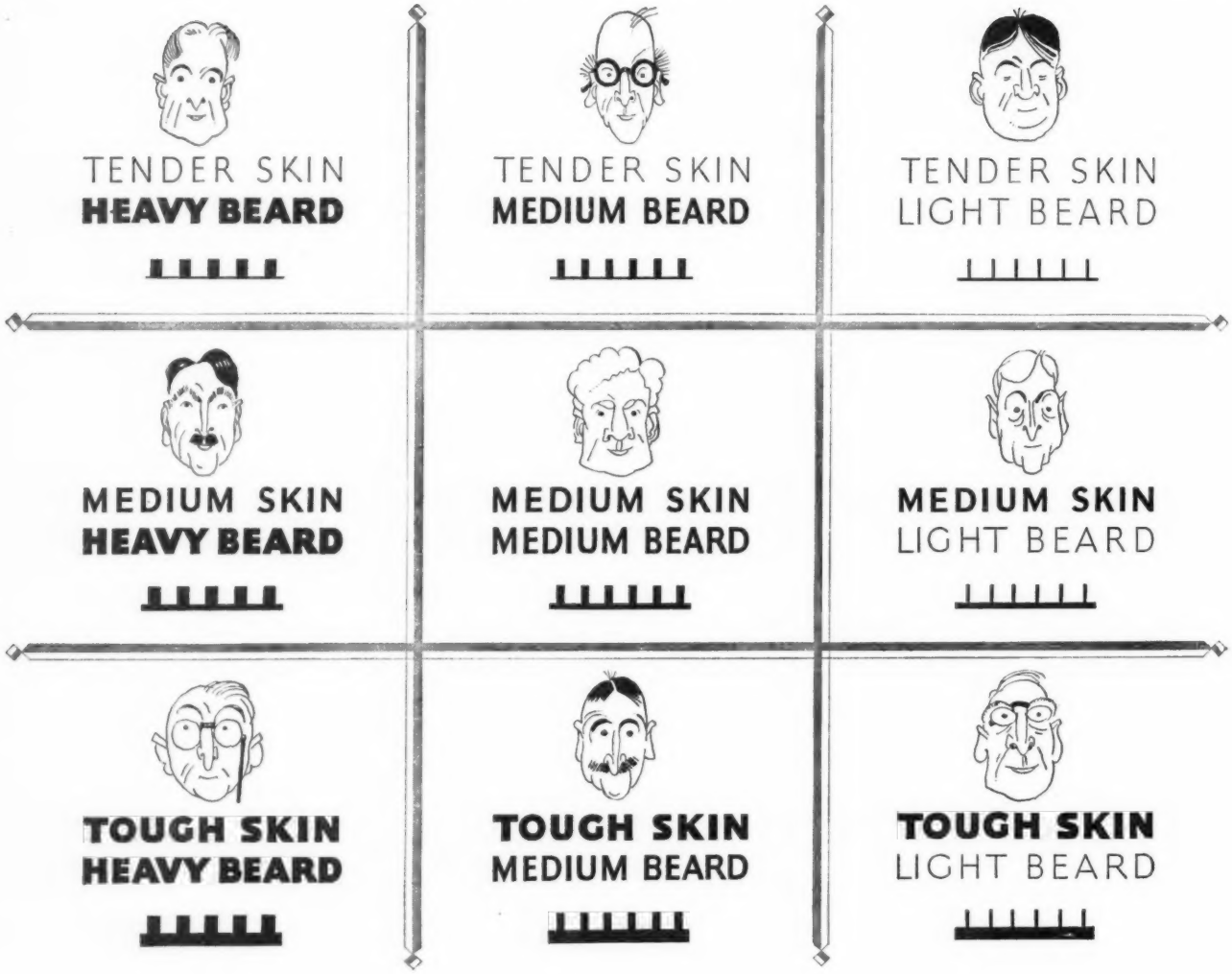

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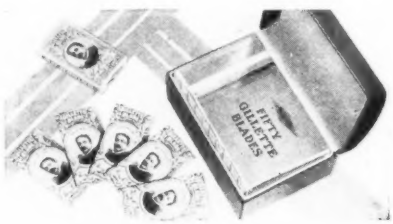
But even under the worst possible conditions you can count on the Gillette Blade to do its job smoothly, surely and well. It's the one constant factor in your daily shave. Gillette Safety Razor Co., Boston, U. S. A.



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SCIENTIFIC AMERICAN

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June 1929 — *Edited by ORSON D. MUNN* — *Eighty-fifth Year*

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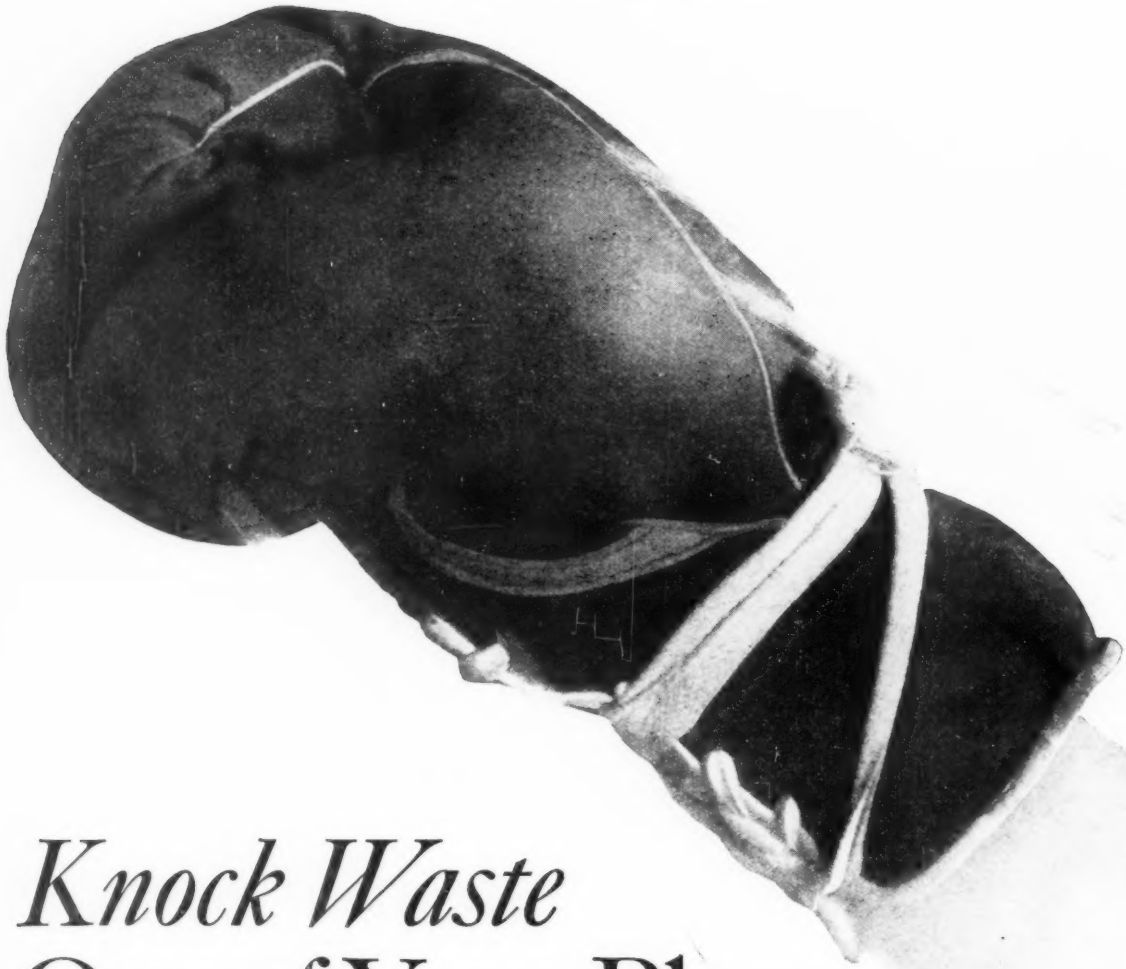
COVER

Our cover this month shows a curious mingling of the old and the new. Here our artist, Howard V. Brown, shows native helpers putting together statues which had been broken purposely and in anger, as described on page 522. We recognize at once an American differential hoisting block and an American winch.



Knock Waste Out of Your Plant

It is a fight to the finish—Industry *vs.* Waste—but Industry now knows how to win.

Power relieved from friction by Timken Bearings, puts a powerful punch into production.

—*And down goes Waste for the count.* Timken Bearings put fighting machines into every field, free from high maintenance, premature wear, misalignment and breakdowns.

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Looking Ahead *With the* Editor

Of Course It's Safe

LADY MARY HEATH has written for us an illuminating article on aviation safety. In her article, which is to be published soon, she points out that, while as a rule people are inclined to be hysterically impressed by news of an air tragedy, the percentage of accidents is very low and those that occur are usually attributable to carelessness or the desire to stunt. Further, she tells of certain safety devices needed and explains why she believes in the great future of aviation.

O_3

THIS ozone, this "150 percent oxygen" in the earth's atmosphere that prevents a life-exterminating potency of ultra-violet rays from reaching us—just what is it? How identified? How produced in the atmosphere? How obtained in the laboratory? Heavier than air, how does it remain as a layer far above the earth? How deep is the layer? A significant article in an early issue answers these and other questions.

"Carretera al Mar"

RATHER incredible that the building of a highway should become a burning national passion, isn't it? Yet that is what happened in a department of Colombia. Its capital, with 100,000 people, an ideal climate, a wealth of natural resources, a tremendous production of coffee and other commodities, was almost isolated by mountains. Read in these pages soon the story of the 255-mile road they are building to the sea.

Neglected Mushrooms

WHO does not like mushrooms? Very few people, indeed, of those fortunate in being near a source of supply. But there are others who like them, too, yet live far from mushroom markets and are afraid the mushrooms in the fields and woods about them are poisonous. In a coming article an authority on the subject will describe the edible varieties and tell how you may gather literally hundreds of pounds of them.

Over the Andes and Beyond

THE inauguration recently of air mail lines from the United States to South America is an event of great importance in aviation. Besides the service they will render, they will serve as a closer tie between the nations and will foster a spirit of mutual friendship. But, as explained in an article now ready for release, aviation is not at all new in South America. Look for this surprising Latin-American aviation-travel story.

Every Issue Fully Illustrated

¶ To keep abreast of the times, you must keep pace with the advances of science. For only four dollars, the SCIENTIFIC AMERICAN *will keep you informed of the latest happenings in the world of science for a period of twelve months.*

Among Our Contributors

Walter Miles

DR. MILES is well known for his many notable researches in psychology and physiology. Since achieving his doctorate at Iowa, he has taught in several large institutions of learning, was for years in the research laboratory of Carnegie Institution, and is now Professor of Experimental Psychology at Stanford University. He frequently collaborates in experiments with Mrs. Miles, also a Ph.D.

Paul R. Heyl

THOSE of our readers who have not seen Dr. Heyl's photograph, possibly picture him as some sort of myth—so rare is the really great scientist with the happy faculty, possessed by Dr. Heyl, of describing a most abstruse scientific subject, experiment, or phenomenon in such a manner that the layman reads the article avidly. But Dr. Heyl is far from being a mythical person—he is a very human person as well as a scientist.

Ernest N. Patty

DR. PATTY has studied at first hand the geology of the vast wilderness of Alaska which is so little understood by the public and for which a great future may be predicted despite its sub-arctic location. His studies may lead to a better understanding of this, our last frontier, its potentialities and its resources. Dr. Patty is Dean of the Alaska Agricultural College and School of Mines located at College, Alaska.

Karl L. Kithil

MR. KITHIL is a consulting engineer of note in a wide field of mining, rare earths, rare metal ores, determination of sub-structural earth conditions, et cetera. An interesting research recently carried out by him was the determination of the magnitude and effect of vibrations in buildings caused by blasting operations a mile distant.

Francis P. Mann

FOR years Mr. Mann has resided in Paris, has kept in touch with the doings on the Continent, and has contributed many articles to our pages. This month, he tells of the French registration of new paintings, a procedure designed to obviate, in future, controversies relative to their authenticity.

Aircraft Industry

Enjoys Unique Advantages in Los Angeles County

32% of the aviation activity in the entire United States centers in Southern California. (U. S. Dept. Commerce)

Available investigations by meteorologists, industrial engineers and aviation authorities show conclusively that atmospheric, geographic, industrial and other conditions here are particularly favorable to aviation industry.

12 major factories are now manufacturing airplanes and aircraft motors here. Highest type, experienced, skilled labor is available; 20% of all licensed pilots; 20% of all identified aircraft; 25% of all aviation schools in the United States are in Southern California.

There are 50 or more airports and landing fields in Los Angeles County alone. (See graphic map at left).

Climatic and other conditions are bound to make this the aviation capital of America. The advantages of this immediate territory are not to be had elsewhere.

Industry Here Enjoys:
Freedom from Labor Trouble
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Cheap and Abundant Power and Water
Cheap Fuel
Low Building Costs
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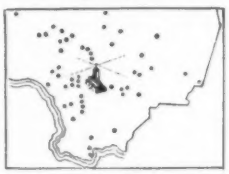
Splendid Export, Rail and Highway Outlets

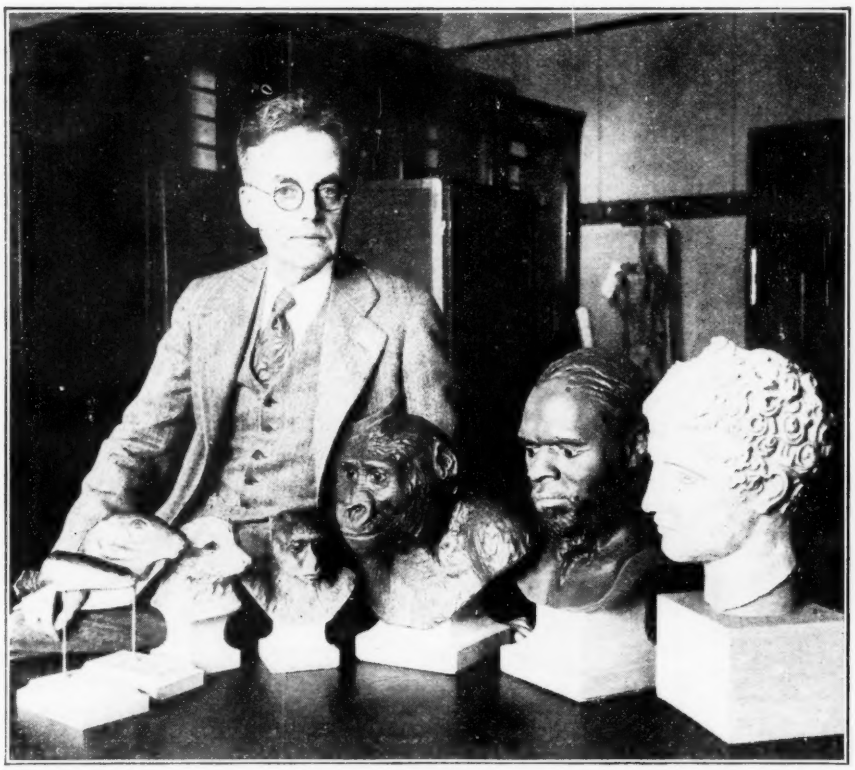


Above map shows part of Los Angeles County. Every dot represents an airport or landing field.

Complete detailed surveys and information promptly furnished upon request to the Industrial Department,

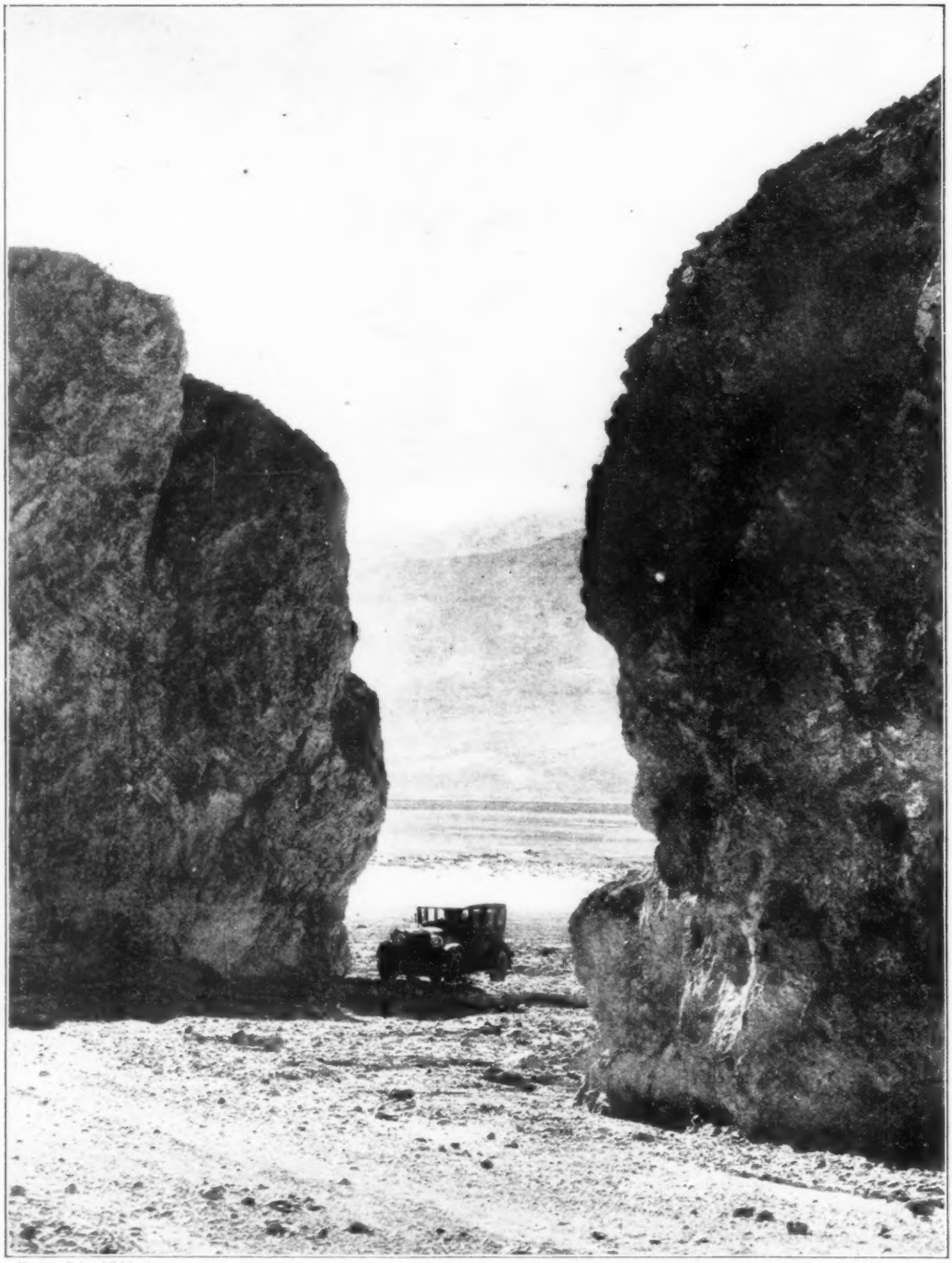
LOS ANGELES CHAMBER of COMMERCE

Air-minded LOS ANGELES COUNTY



William King Gregory

TO some the words paleontologist, morphologist, and ichthyologist, which apply to the distinguished American scientist whose picture appears above, may call up thoughts only of dry, lifeless fossils and decades of close application to the dull stodgy archives of science pursued in some dusty attic workroom amid a profusion of biological specimens preserved in alcohol. If this be the reader's first thought let him cast it aside. We know of no more human, modern scientist than Professor William K. Gregory of Columbia University and the American Museum of Natural History. Paleomorphologists who answer to the above description there may have been in some past generation; but such scientists, somewhat fossilized themselves if the truth be known, are nowadays as rare as some of the fossils they studied. Modern morphology is the science of evolutionary changes in the forms of animals. Paleontology sometimes reveals the fossil records of these changes. The paleontologist and morphologist must of course be a comparative anatomist. He makes critical comparisons between homologous features of various types of animals, fossil and living, and familiarity with these and other anatomical features enables him to see about them altogether more than the outsider could be expected to see. This is true in any vocation, no doubt including the reader's. Surprisingly definite laws control the evolutionary changes in form of all animals. A thorough knowledge of these natural laws enables the morphologist to deduce much concerning the probable forms of extinct animals which are still missing from the fossil record, and many cases are on record in which the later discovery of the missing fossils have vindicated such deductions. The paleomorphologist, then, is primarily a student of evolution. What more fascinating field of science could there be? Dr. William K. Gregory is America's foremost paleomorphologist. His specialty—if so very inclusive a scope can be called a specialty—is all of the vertebrate or backboned forms of life. This begins essentially with the first fishes (hence "ichthyology") hundreds of millions of years ago, and follows through their successive descendants —the amphibians, reptiles, and mammals, including man. Dr. Gregory's latest scientific work, "Our Face from Fish to Man," traces this long line of evolution by means of the various parts of the head. In the photograph he is shown with casts exhibiting the main stages of this evolution. "The Origin and Evolution of the Human Dentition" is another of his books. It treats of the relationship of apes and man, especially as shown by the teeth. Dr. Gregory's attainments were recently recognized by the National Academy of Sciences, which elected him to membership in that noted body in 1927.



Courtesy *Pictorial California*

Imposing Gateway Into Golden Gulch Canyon

ON the completion of a new road, an added lure will be provided to this spectacular region. Death Valley, in southeastern California, is 323 miles northeast from Los Angeles and 200 miles east of the Pacific Ocean. It is a long narrow sunken desert rimmed by high mountains. Its sun-baked floor is from 100 to 300 feet below sea level. Death Valley is 150 miles long and from 10 to 35 miles wide. The floor of this valley was once the bed of a shallow lake or inland sea. The color scheme is a blend of white, tan, and chocolate tones. See also page 521.

EXPLORING A STREET CROSSING FOR A FAVORABLE OPENING

Record A of Figure 3 gives a concrete idea of the actual movements of the eye at such a time. The subject is awake and alert. If extremely sleepy, the eye will perform badly, as shown in other records

Sleeping with the Eyes Open

Scientific Research Demonstrates That a Motorist or Anyone May Actually Be Asleep, Even if the Eyes Are Seen to Be Open

By PROFESSOR WALTER MILES, Ph. D.
Psychology Laboratories, Stanford University

IT is commonly supposed that sleep begins with the closing of the eyelids. Actors represent it so and children do the same. Of course when we *decide to sleep* we voluntarily close our eyes to favor the starting of this mysterious state. By dropping the lids we clear the "perceptive screens" of all forms and actions and thus we quiet down the visual centers. Then sleep may come—but not always. It is not wholly a matter of eyes or of visual centers, prominent as these are in the waking mental life of most individuals.

On the other hand, when *sleep overtakes us*, when we fall asleep contrary to our expressed desires to continue active, what is the real order of psychological events? Do we fall asleep with the fall of the curtains (lids) or before or after? Is it possible that drivers of vehicles and others carrying on tasks of much responsibility that are supposed to require practically constant vision sometimes really sleep while their eyes are still open? Such individuals, spurred by thoughts of the importance of staying awake and keeping the wheels turning, may possibly be able to control their muscles better or for a longer time than they can keep their retinas sensitive and active.

Profound sleepiness of the "overtaking variety" is not so easy to provide in the psychological laboratory. The case here reported and made the basis of this discussion came as a by-product in another experiment. The young man was a skilled typist earning a good salary. At the time of the experiments he was planning to get married and was very anxious to earn extra money. Therefore he had gladly arranged to serve as a subject in some night experiments on typing. He had agreed to a program of hours of sleep, and other routine for the consecutive eight days of the experiments. It was discovered later that he was not faithful to this program of sleep during the preliminary period. He did not retire until about 2 o'clock on two consecutive nights, and then came to the laboratory the next evening. He expected to bluff it through so that he might get his money, and I must say he did pretty well. But the eye-movement camera caught him and caused his confession.

THE technique which we used for recording the eye movements I have already described in the SCIENTIFIC AMERICAN.[1] The eye not only serves as a small mirror, but the reflected image, be it window light or arc light, moves about in the eye with the movements of the eye. This movement of the image is due to the fact that the cornea (dark part) has a different curvature than the eyeball. If you change the position of this cornea, that is, turn it to the right or left, or up or down as is done when looking at different parts of a picture, you change the angle of reflection, and so the apparent position of the image. See Figure 1.

An illustration will make the principle of recording clear. Figure 2 is a picture, enlarged two diameters, of a human eye taken on a still plate. The resulting photograph appears grotesque because the eye moved during the exposure. First the eye was looking approximately in the direction of the reader's right shoulder, and the image of an arc light (the white spot) was also at the right in the photograph. Then when the exposure was half over the subject turned his eye as if to look at the reader's left shoulder. Now the image of the arc passed from right to left and it will be noted that the eye must have stopped at three distinct points. This is demonstrated by the three white spots at the left in the picture. A perfectly spherical eyeball would show no shifting of the arc-light image with such movements.

If in place of a stationary plate, as used for Figure 2, we use a steadily moving plate or film and a magnification of about nine times, and ask the subject to look alternately right and left to certain points, we secure records like those illustrated in Figure 3.

We must now give some consideration to the interpretation of such records before taking up the behavior of the eye during profound sleepiness. In A of Figure 3 we have a record which probably represents the typical

1. "When Reading, Your Eyes Move in Jumps", SCIENTIFIC AMERICAN, November, 1926, pp. 354-356.

movements and pauses of the eyes of an individual who is looking back and forth before crossing a city street. The points to be looked at are many, and they are of unequal value as sources of interest. New ones may momentarily appear or old ones change on either

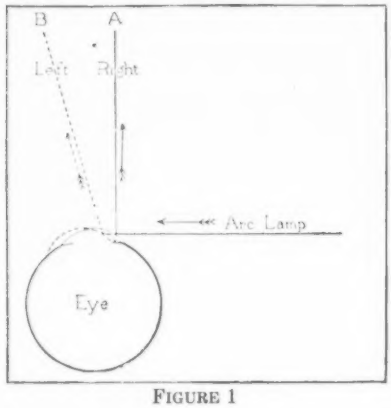


FIGURE 1

side, hence the observer tends to alternate fixation from one side to the other.

Figuratively speaking, from the many items on the ledger before him he momentarily strikes a stimulus balance and invests his behavior just then accordingly. In the record, the nearly horizontal dotted lines represent movements of the eye, shifts from one thing or position to another, each dot having a time value of 1/100 of a second. The vertical lines represent fixations, that is, steady pauses of the eye during which some object is consciously seen or in some way evaluated for the individual's behavior.

At the bottom of record A the shift of vision from right to left occupied .15 of a second. On the return movement, looking back to the right, the motion was started very rapidly but the individual batted his eye and so shut off the reflected light. In the other movements the time required varies from .03 to .10 second, approximately, according to the distance moved. An individual can not voluntarily control this rate of movement of the eyes. He of course controls the movement in the sense that he can keep his eyes fixed on an object or can shift them to a new position. Having made the choice to shift he has no control to make the movement itself quickly or slowly.

This type of eye movement is also employed in reading the printed page or in viewing a picture, and has been named the "saccadic movement." When we read fairly difficult prose material, the eye pauses for about .30 second; then makes a movement of one or two degrees of visual arc, executing this movement in approximately .01 second; pauses again for a fixation of about .30 second; makes another movement, and so on to the end of the line; whereupon there is a long movement from the right to the left-hand end of the next line of print. This last movement of adjusting to the next line will require perhaps .05 second.

Moving the eyes a distance of 40 degrees between two given points requires about .10 second. This value is so regular for adults in normal condition, and is so even for a given person for different days, that we may make it a measure to indicate physical and mental condition. As a measure it has the advantage of being somewhat like a reflex, while retaining certain features of voluntary action.

RECORD B in Figure 3 is normal and typical for this eye-movement test. The individual has looked back and forth alternately between two points that are 40 degrees apart. The looking and recording has been done with the right eye while the left eye was covered with a shield. We notice four characteristic features: (1) The lines of dots indicating movement proceed fairly directly from right to left and left to right, that is, they have very little curve in them. (2) The movements are faster in going from left to right. (3) When the individual is looking at one of the prescribed fixation points, the eye inscribes a vertical line which has very little tremor or lateral deviation in it. (4) When the eye makes the big saccadic movement it frequently stops short of reaching the mark and a corrective movement is required. See points 1, 2, 3, and 4 marked on record B. The amount of time elapsing before the corrective movement is executed is one reaction time (about .16 second). The

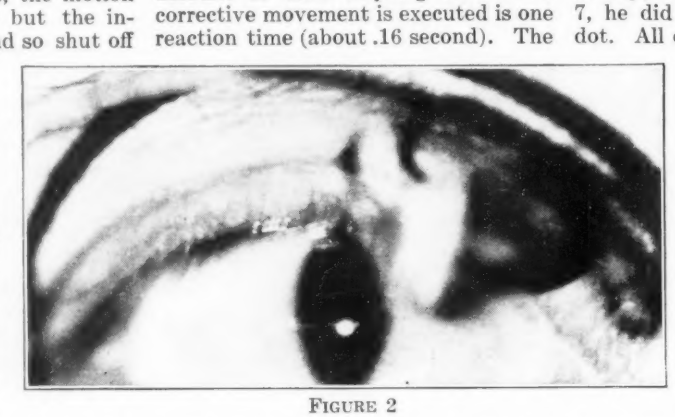


FIGURE 2

retinal field must clear up, visual impression must become distinct, and the individual realize that he is not seeing the desired fixation point with greatest clearness—only then will he move the eye over.

We may suppose that this last characteristic, the corrective movement, is present only when one desires to reach visually a specific point in the field. When visually exploring surroundings at the street crossing, we probably make none of these corrective movements (see record A). On the golf course, however, I look to one side and then want to look back at the flag, whereupon my eye will execute the main jump to the vicinity of the flag and then a short movement to bring me exactly on it. The normal pattern of eye movement, in fact, resembles golf—I make a long drive to reach the green, and then a putt to sink the ball. But the eye makes no preliminary false motions.

The person who made record C, Figure 3, began (see bottom of record) with a fair amount of care. This is shown by the corrective movements the first and second time he fixated the left-hand mark. Later he contented himself with whatever position of proximity to the dot his eye happened to reach with the first movement. In record D this same young man attained even higher speed and made even shorter fixations. In no case in this latter record did he make a corrected movement. We notice that his successive fixations at the right line up vertically fairly well, that is, he found the right hand dot with fair accuracy. The fixations on the left show quite a little deviation, a maximum range of about five degrees. Not many individuals can move the eyes as rapidly as did this man. Each dot represents .01 second and the stretching out of the dots on the record is due to the speed with which the eye is turned.

ANOTHER man in record E shows far greater inaccuracy in carrying out the fixations. He grossly neglected the instruction, "look at each dot distinctly," and sometimes, as at 5, 6 and 7, he did not go near the prescribed dot. All of these records from bottom to top required about seven seconds. These records have familiarized us with the main features characteristic of saccadic eye movement measurements using a standard distance of 40 degrees of visual arc.

In Figure 4, record F is given as representing an ideal eye-movement test result. This includes two tracings, 1 and 2. The movements were direct and quick, they indicate an attempt to be exact, which is shown by the corrective movements. The fixations after correction show that the individual consciously and precisely saw the mark—he was awake and alert.

Now let us turn specifically to the records made by our typist subject mentioned above, who was *very sleepy*, having grossly transgressed the sleep instructions agreed upon for the evening

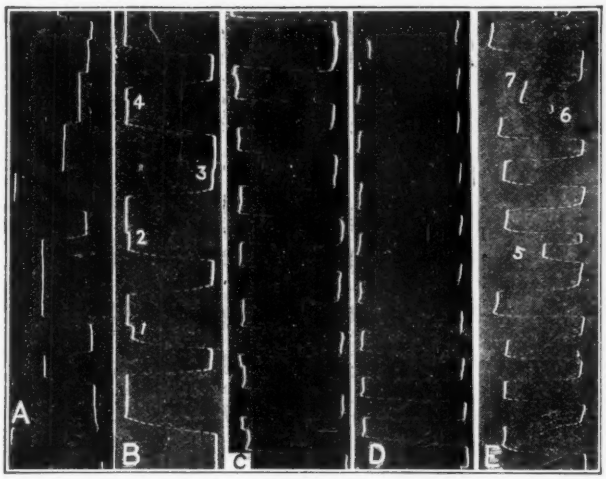


FIGURE 3

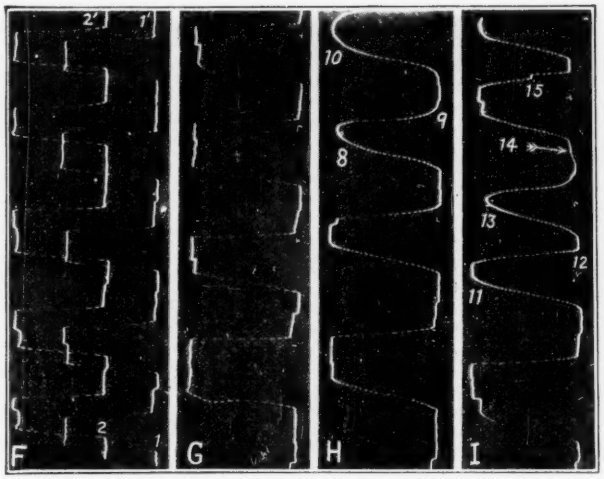


FIGURE 4

experiments on typewriting. He talked and laughed and tried to bluff himself and the experimenter into the impression that he was "peppy." Notice what the eye-movement camera caught! Record G, Figure 4, was made at the beginning of the evening. It is in marked contrast with the normal (see F) in two particulars: First, the movements are much slower (many more dots to cover the same distance than used in F); second, the movement lines, particularly the one at the bottom and the one next to the top, are curved, indicating that the eye rolled up. In nearly all cases a corrective movement was indeed made and the points were fixated accurately without much wavering of the eyes.

NOW when we take him two hours later, during which time he has been employed at a variety of typing and other light tasks, we have record H. Starting at the bottom it will be seen that the first movement, although wavering, is fairly direct but is *very slow*. The time required is about .25 second, more than twice as long as the usual time for this visual-motor act. The fixation at the left which resulted was preceded by a small corrective movement and was apparently adequate and steady. The next movement was to the right. This was considerably quicker, but much slower than is usual for such movements (see records B, F, and also G). The next movement to the left (third dotted line from the bottom) is very slow and has no corrective movement. Following a short fixation there is a small jerk to the right, which is an oddity in such tracings. The movement to the right (fourth dotted line from bottom) terminates very slowly and no corrective movement appears. The fixation line is not truly vertical but wavering. From this the next movement begins with fair promptness, as witnessed by the moderately sharp turn to the left, but the movement is executed at a snail's pace, as shown at the right of 8.

Now (at 8) occurs a change which so far as I know is entirely new in the description of saccadic eye movements. The movement converts itself into a pendular swing or roll of the eye from side to side at a very slow rate. There is no moment of holding the eye steady for fixation, there is, in fact *no seeing*. The retina is insensible, the visual centers are inactive, the individual is asleep. His eyes are open, they continue to move for awhile (swing over to 9 and back to 10) under the drive or perseverative tendency of the regular muscular action just engaged in, but the movements are without point or purpose. They take the eye here and there while the eye, insensitive, sees nothing anywhere. The

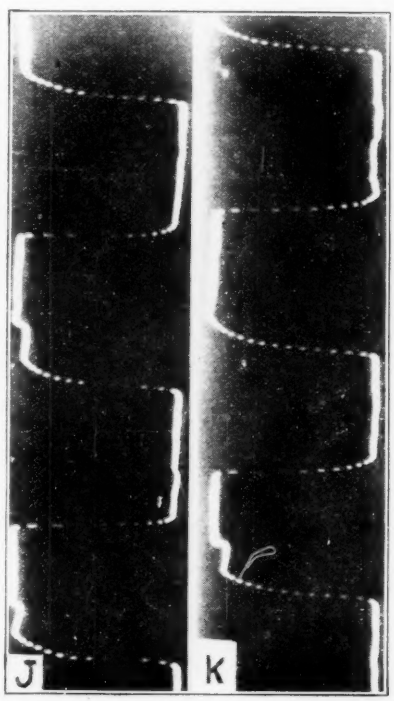


FIGURE 5

man urging himself and psychologically whipping himself to keep awake has kept his eyelids open but has not succeeded in keeping his retina active or his visual centers awake.

Our same sleepy typist made record I. This started with a wink which cut off the light. There was a corrective movement and wavering fixation following at the left. The first movement to the right was slow. It was followed by a slow corrective and a wavering fixation, if it may be called fixation. The typist was apparently not quite asleep; his eye did stop, when he reached points 11 and 12, but after 12 and especially at 13 he was quite oblivious to retinal impressions. During the slowed up period of eye movement at 14 there was partial arousal of his visual centers. He wakened probably at or about the position of the arrow. The eye crossed to the left fairly directly but very slowly; there is a corrective movement and some fixation. Then the typist sinks again into sleep, the movement to the right is interrupted by a short break at 15, there is a pause at the right-hand mark and then the rolling movement starts; he is asleep, and the record here terminates by the closing of the eyelids.

THESE two records prove conclusively that it is possible to go to sleep when the eyes are open, even if the individual is strongly motivated to stay awake. They are exhibits which indicate that retinal sensitivity is of chief importance in defining wakefulness. The movements of the eyes have no important function other than that of directing the eye so that images of particular points and outlines can fall on sensitive receptors. Ordinarily, when we invite sleep we inhibit eye movements, close the lids, and reduce the stimulation to a minimum, but this is not the cause of sleep as a psychological state. Sleep may come on while the eye movements are going, the lids

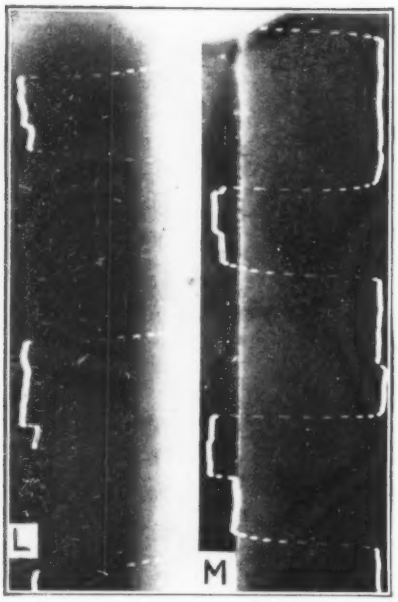


FIGURE 6

open, and the individual striving to proceed with his visual task.

There are a number of criteria which we may use as indicators of profound sleepiness and which are revealed by certain of our photographic records. Dr. H. R. Laslett[2] carried out an experiment on the effects of the loss of sleep at the Psychology Laboratories, Stanford University, in 1926 under the direction of the writer. He had a group of men stay awake for a period of 72 hours. Many different kinds of measurements were made on these individuals and a few eye movement records were taken. Most of these latter were failures due to a misunderstanding in reference to the photographic materials employed. A very few of these records taken about 66 hours after wakefulness began may be shown as illustrating certain of the criteria of sleepiness.

THE pair of records reproduced in Figure 5 show slow speed of movement as our *first criterion*. The movements to the left are .13, .16, and .16 second. Those to the right are .11 and .13, respectively, for record J. In record K movements to the left are .14, .14, .15; to the right .11 and .11. These are seen to be slow when we compare them with the usual average of .11 for movements to the left and .10 in movements to the right. The slowing occurs especially in moving to the left.

The *second criterion*, wavering fixation, is also demonstrated by Figures 5 and 6, particularly in L where occur, at the right, curious temporary deviations in fixation.

Criterion three is interference or failure in reference to the ordinary corrective eye movements. As an illustration, see record M, Figure 6. The first corrective, bottom of the record, is abnormally large and, in fact, so large that it is followed by a small corrective in the opposite direction. The next movement, first to the right, is too large and has to be followed by a negative correction. The second fixation at the left has first a positive movement and then a small movement of corrective nature in the opposite direction. Similarly these oddities in corrective movements are seen also in the records of Figure 7 and particularly in record P of Figure 8, where at the left the individual makes pairs of corrective movements in the same direction.

Criterion four consists in breaking the long saccadic movement into shorter movements, that is, interrupted saccadics. Records N and O of Figure 7 are examples of this. These short, nearly vertical lines which occur about midway between the right-hand and left-hand terminals of movements are, so far as I know, peculiar to the condition of profound sleepiness. A short break of this nature occurs near the top of record I, Figure 4, made by the sleeping typist. Notice that these breaks are not accompanied by corrective movements. The individual is not trying to see any specific point.

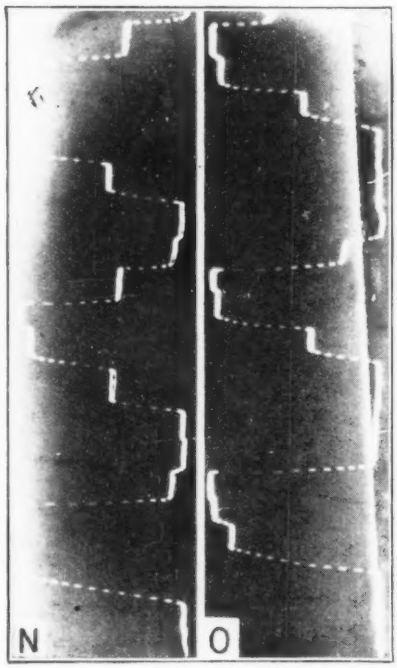


FIGURE 7

Criterion five is the change from the typical saccadic jerk of the eye to the rolling, pendular type of movement. This is unaccompanied by a perceptive fixation; the eye does not stop and it does not see. This tendency shows first as a very slow termination of the usual saccadic movement. See top of the chart designated by Q in Figure 8.

The quick-moving, steady-gazing, well-opened eye, denotes the confident, wide-awake person. The slow-going, gaze-shifting, dull eye, somewhat rolled up so that the upper lid half covers the pupil, tells us that the possessor is drunk or drugged. So in a general way we recognize the symptoms of profound sleepiness. In this state, vision is dim (sensitivity of the retina is less than normal) and we might say insecure (it is hard to maintain fixation). It is difficult to keep on the line of print, the eyes close up shop even though we ourselves have declared for another hour of business, and we have to use the whip to get overtime service.

STUDY of the eyes during profound sleepiness and at the moment of falling asleep is a new field of research. At present we do not know enough about it to give a temporal sequence for the appearance of these various criteria of sleepiness. We do not know whether certain of them are especially typical for certain individuals. Our experiments, which in general must be made as circumstances offer opportunity, have clearly shown that the eye-movement records of the sleepy give marked differences from those made by the wide-awake. The sparkling eye is the quick, steady eye. The eye of the sleepy glides, wavers, and is fitful in its "hold" on the important objects of the environment. Sleeping is not primarily a condition of closed or open eyelids but of the retina and the visual centers. Just because we can see the open eyes of a person is no reason why we should testify in court that "he was wide-awake."

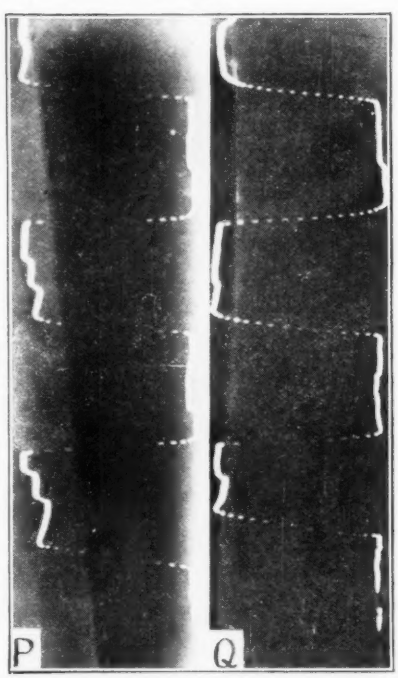


FIGURE 8

2. H. R. Laslett, "Experiments on the Effects of the loss of Sleep." *Jour. Experimental Psychol.*, October, 1928, p. 370.

OUR POINT OF VIEW

S. O. S.

IN October, 1797, there was launched at Hartt's shipyard in Boston a frigate that was to make history. Named the *Constitution* and later affectionately called *Old Ironsides* in tribute to her staunchness, perhaps her best known service was the subjugation of the tribute-levying Barbary pirates of Tripoli in 1804, but she fought many other victorious battles and captured many men-of-war. Some of the finest, most glorious traditions of the United States Navy are enshrined in her small bulk.

Although she survived a century and a quarter, she seemed destined for the junk pile a few years ago. In 1925 Congress authorized her restoration by public subscription and the work was started. Lithographs of her were sold to raise funds. That was insufficient. Now, solid old oak from her hull, copper from her sheathing and bolts, and lead from her magazines have been utilized in making historical souvenirs, appropriately and beautifully stamped or molded to show the source of the material. There are paper knives, cigarette boxes, ash trays, small cannon, anchor paper weights, et cetera; and one of these will be given to each contributor to the rebuilding fund. The lithographs are still for sale, and there is also a set of plans for sale, giving instructions for building an exact model of *Old Ironsides*. All these have been designed in order to collect the funds necessary for completing the job.

Back this worthy undertaking to the limit. Send your dollar, five dollars, ten dollars, or what you will, to District Staff Headquarters, First Naval District, Navy Yard, Boston, Massachusetts, and ask for a catalogue of the souvenirs. Remember, *Old Ironsides* was a most valiant ship in her day and, as the Navy says, "Save Old IronsideS is the only S.O.S. she ever knew!"

The Layman Learns

SOME of us are inclined to scoff at guide books but in Oklahoma "guide books" of a different kind are gaining the attention of thousands. These are in the form of signboards along a highway leading out of Ardmore and, very strangely, are descriptive of the various geological formations exposed on the surface of Arbuckle Mountains. It is said that, with the exception of glacial and volcanic phenomena, almost the entire gamut of geology may be observed in these mountains. The signs were placed by the Ardmore Lions Club and the Ardmore Geological Society, the moving spirits in the undertaking being Drs. Charles N. Gould and C. W. Tomlinson.

At first glance, the attempt to interest the layman in geology in this unique manner would seem to be futile. But in Oklahoma, geologists are no longer looked upon as pedants. This is due mainly to the facts that Oklahoma ranks second among the states in mineral production, ranked first last year in oil production, and that geologists are largely responsible for the discovery of the 300 oil fields in the state. It is said that it is not uncommon to find dozens of cars lined up at the signs while their passengers study them. "Thus, in Oklahoma," said Dr. Gould recently, "we are humanizing geology."

Science is such a matter of every-day concern that we heartily approve of this movement. It is to be hoped that it will extend to other states, be enlarged upon, and improved to humanize a wider field of scientific study than geology. The layman has too often been accused of shallowness. We believe that, if given a chance to find out about the things with which he comes in contact every day, he will prove up nobly. He has in Oklahoma and he will elsewhere. Tell him what he wants to know.

Television's Future

TELEVISION is a subject which intrigued the popular imagination for many years before successful demonstrations of the art were carried out. Now, therefore, that the science of "seeing by radio" has been demonstrated as being practicable for use by persons not highly versed in the technical side of radio, a word of warning seems propitious. Dreams of life-sized images at a television receiver are all right in that they may serve as inspiration for further developments, but sometimes they may serve to delude those who will, in the final analysis, be the greatest users of television. We speak of the general public.

On another page of this issue, we present a description of some of the latest advances in television technique. We tell of home television receivers. But don't get the wrong impression. The television images which can be received today are small and crude. They bear little resemblance to the "radio movies" which are fancifully pictured by some. But they are a step forward. The future holds promise of big things to come, but these big things are not here as yet. We hope that many of our readers will become interested enough in television in its present stage to build experimental receivers and "look in" on the programs being broadcast. It is in this way that the greatest progress can be expected—by contant experimental work under actual field conditions.

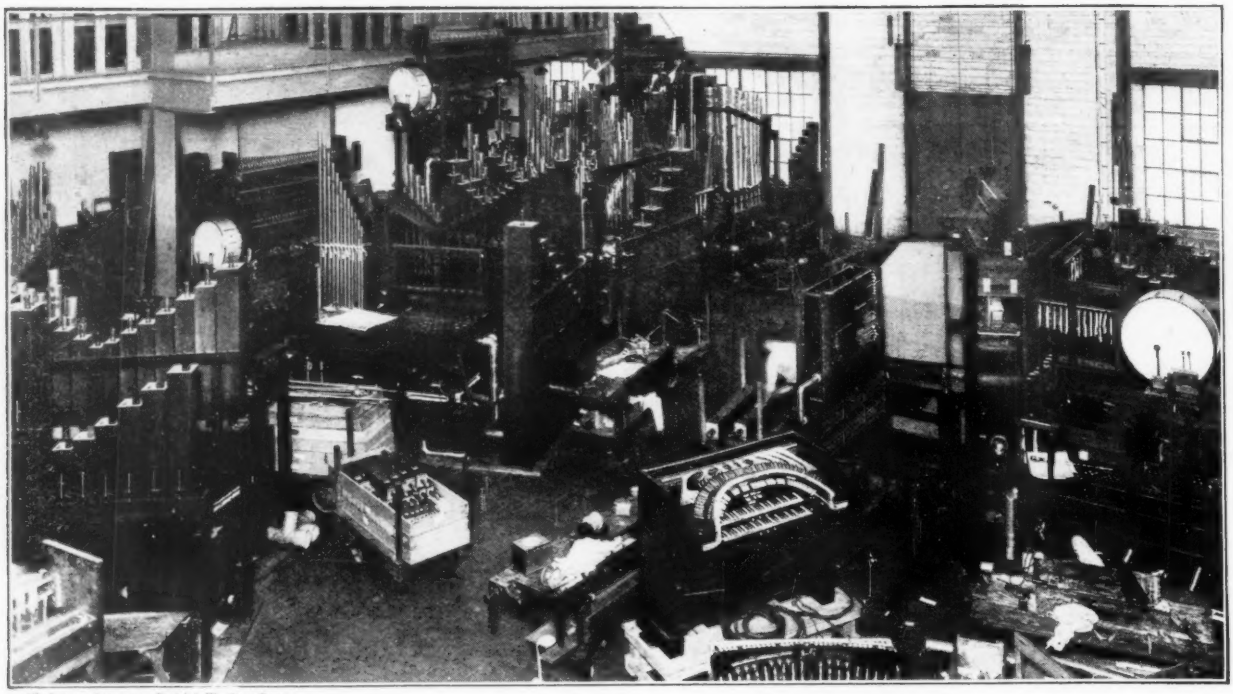
Submarine Safety

THE special board appointed by the Navy Department nearly a year ago to investigate submarine safety devices and schemes has just completed its task and rendered a complete report. Following the tragedy of the *S-4*, 4971 such ideas were submitted to the navy by people throughout the country. Most of these were quickly thrown out as being of no value or impracticable but 353 of them were selected for further study. Several of the latter have been approved by the board.

Most important of the approved devices is the "artificial lung" by means of which not only divers but officers as well have "saved" themselves without outside aid. Naval experimenters using the "lung" have brought themselves to the surface from a depth of 155 feet by climbing hand over hand, slowly to prevent divers' bends, on a line tied to a floating buoy. The "lung" is similar to a gas mask and contains oxygen and soda lime.

Lifting eyes on submarine hulls have hitherto been frowned on but the board approves them. The board approves double tubes in submarine hulls, for delivering fresh air, food, and water to imprisoned crews. It also sees value in the diving bell which can be placed against escape hatches to receive a number of men and bring them to the surface, but recommends further tests. Of the other devices suggested, detachable escape chambers would add too much weight; powerful magnets to lift sunken submarines are impracticable; and submarines specially designed to rescue crews of sunken submarines are of doubtful value; consequently, schemes such as these were disapproved.

It will be seen, therefore, that the navy is keenly aware of its most vital problem and is open-mindedly considering every possible solution. Experience has been such a hard teacher that the navy has determined to prevent, if possible, any repetition of the tragedy that befell the *S-4*, and to that end will continue to investigate and experiment. Hereafter, if a submarine sinks in reasonably shallow water, it is anticipated that the men, if still alive, may quickly save themselves or be saved without delay.



All photographs courtesy Rudolph Wurlitzer Company

ALL THE ELEMENTS ARE ASSEMBLED IN THE ERECTING SHOP

The hundreds of pipes, the cables with their miles of wire, the drums and other actual instruments which are to be incorporated are all brought together and correctly assembled. Air at various pressures is available at all points in this room where the organs are tested

Modern One-Man Orchestras

Organs for the Church, Theater, and Home Require Skilled Workmanship if They Are to Render Good Service

By ALBERT A. HOPKINS

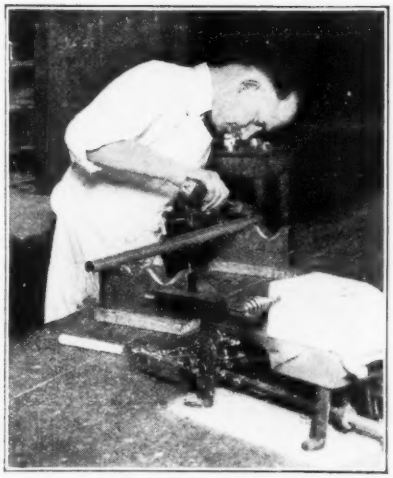
THERE was a time when every theater had an orchestra of at least four or five pieces. Sometimes the music was good; but often it was indifferent. The public wanted something better, and the demand was met by the "unit-orchestra" which combined a cathedral organ with an orchestral section. Later, a novelty and percussion department was added, thus combining into one all the different voices of the symphony orchestra—wood-wind, brass, percussion, and string. The organist has under his control a phantom orchestra and an organ which makes it possible to play any kind of music, especially that which requires rapid technique and quick response that was not possible in the old-time organ.

THE great development of the moving picture has both helped and harmed the musician. It could perhaps be expressed as follows; it eliminated the mediocre musicians and gave the competent ones prestige and good salaries. The movie houses waxed prosperous and the seating capacity has risen from two or three hundred to five or six thousand. What is more natural than to supply a great symphony orchestra of, say, 115 pieces when dollars are streaming into the ticket booths by the thousands? Audiences like to see a splendid orchestra come up from the pit playing "Pomp and Circumstance," or some other musical masterpiece. Of course, the orchestra cannot play all the time, particularly when the picture is on, so that here is where the unit-orchestra comes in. Often as the orchestra pit sinks with the musicians still playing, a console rises with the organ expert carrying on.

NO MASS PRODUCTION HERE

Each metal pipe is made by hand. The workman is shown "rolling up" a tube

IN other days organs were built according to the service they had to perform. A church organ was in use only about four or five hours a week while a "movie" house might operate the organ for three times that period every day, seven days a week. The ordinary organ would not "stand the gaff" and it was soon discovered that a new order of musical instrument was necessary. This condition led to the gradual evolution of an organ which would render satisfaction under severe usage. It is this type of instrument that the writer will describe. As you pass along the Falls Branch of the New York Central, just before you reach North Tonawanda, you see a station marked



SOLDERING THE PIPE

The pipe having been formed is soldered and is then ready for "voicing." See below

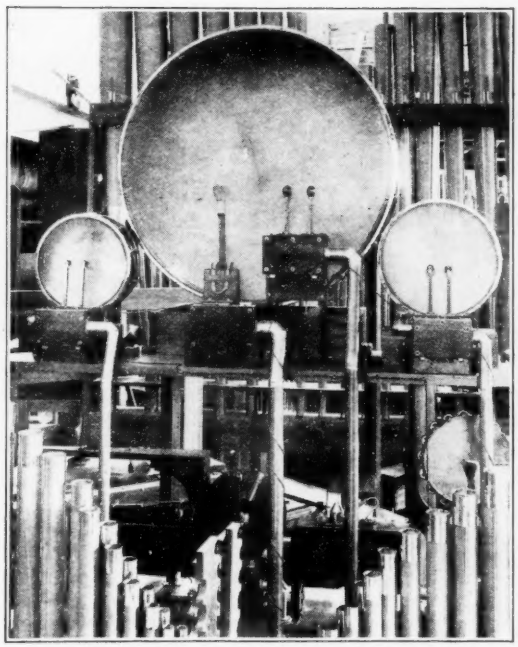
"Wurlitzer," and here these organs are fabricated. The writer spent a day in the factory and the processes were found to be so interesting that we will describe them to our readers.

An organ with the orchestral additions is a very complex piece of mechanism involving thousands of pieces, miles of wiring, and a constant and intelligent supervision. Curiosity is often evinced as to what things cost. When you go to a first class movie-house you may be listening to an organ which costs anywhere from 15,000 to 60,000 dollars and, in some cases, nearly 100,000 dollars is involved. It is only when you see the organs fabricated that you can form any conception of the painstaking care which produces the finished instrument. The organs are all assembled and tested and are then boxed and sent to their destination; if to a foreign country where there is no representation, an expert is sent from the factory to supervise native talent. In some localities an organ would literally be "eaten up" by ants or other insect pests, but this is guarded against by importing from that country wood which is immune, and the leather for the bellows is "poisoned."

ORGANS are designed according to the work expected of them. One intended for a broadcasting studio has the base constructed along different lines from a church or auditorium organ. An instrument for a private house, particularly where there are young and lively people, is apt to be a small edition of the moving-picture house type. Drummer's traps are freely introduced and as the musical talent may lie dormant, the music is often controlled by a perforated roll. An organ for a mortuary is divorced from many of the more florid features usually provided.

An organ, while not as temperamental as a prima donna, does have to be tuned and in a great "movie" house, where the duty is heavy, it is gone over about every week or ten days. Inequalities of temperature is the cause of the pipes getting out of tune. An organ is a long-lived piece of mechanism if carefully looked after.

The heart of the organ is, of course, the pipes, which are made both of wood and metal. It would be manifestly awkward to build a 32-foot "diaphone" out of metal. Therefore, wooden pipes are made of California sugar pine, but some of them, as the flutes, have a hard wood front. After the wooden pipes are made they are "voiced" to give pitch and tone, often with their metal brothers. The metal pipes are made from sheets of tin alloy cast on long linen covered stone tables, smooth as a billiard table, and, in fact, similarly built. Nothing but block tin from the Malay Straits and pure pig lead enters into the composition of the alloy, varying proportions being used according to the tone to be produced.



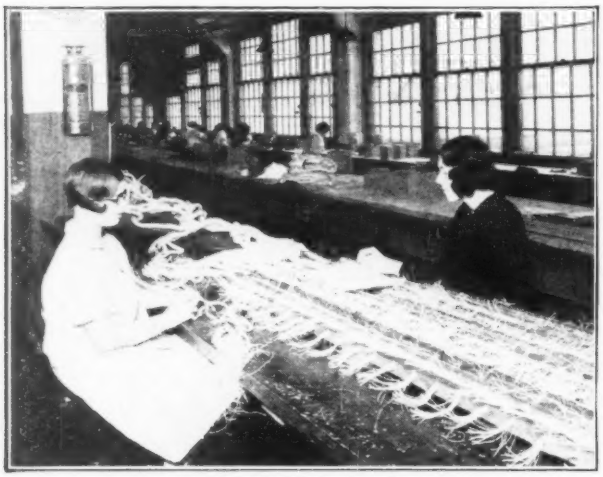
ACTUAL INSTRUMENTS OF PERCUSSION

Drums, tambourines, cymbals, sleigh bells, castanets, et cetera, are introduced into the organ itself, giving better results than simulated effects of the instruments

One of our illustrations shows a pipe maker rounding up the metal body of a violin pipe. After the metal has been cut to scale from the sheet, the pipes are rounded into shape by beating the metal around steel mandre's. Each stop has a minimum of 61 pipes, all of which are of different lengths and diameters, and, in addition, each stop is different from every other; therefore hand work is absolutely essential in the making of metal pipes. The pipe,

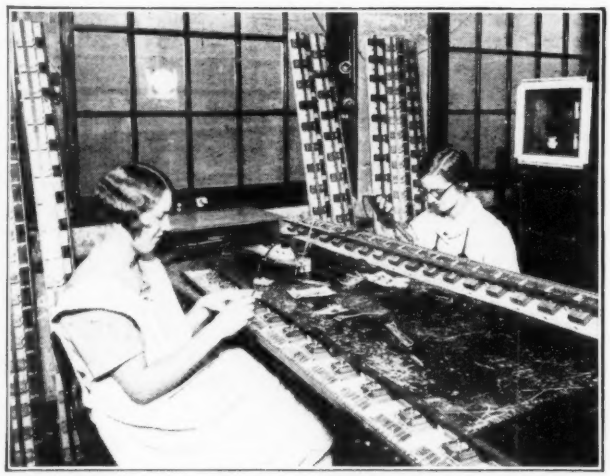
VOICING THE PIPES

The pipes, whether wood or metal, are "voiced" and tuned by experts who compare the new pipes with standards. The mouths of the metal pipes are carefully adjusted by cutting



"RINGING OUT" A CABLE

The cables are all specially formed for each particular organ and are "rung through" or tested as shown before being covered



SOLDERING THE CABLE

The electrical supply wires are soldered to the silver contacts for the electrical action. The requirements for accuracy are rigid

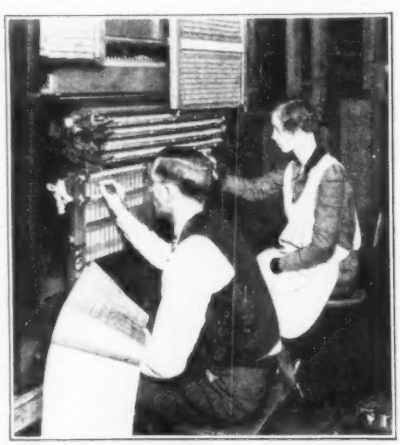
having been formed, is then soldered and is ready to be "voiced." This is the most particular branch of organ building and is carried on in special rooms, of which there are 18 at the Wurlitzer plant. The "voicer" is shown treating an open diapason stop. It is necessary to cut and prepare the mouth of pipes, and one of our illustrations shows an expert cutting a pipe, such as a diapason of violin or flute. In the case of the small pipes a magnifying glass has to be used, the work is so fine.

Other elements which are all essential to the functioning of an organ are the means for supplying wind pressure, control of the air at the individual pipes by means of electricity, and the keyboard or console. The electro-pneumatic action is absolutely reliable, as it has stood the test of time, having been used in organs for over 30 years. It is instantaneous in attack, and is capable of far faster repetition than is possible with the human hand.

THE cable-making department is of special interest. Here miles of wire are cut and spliced so that the behests of the organist are conveyed by these "nerves" to the electro-pneumatic action. One of our illustrations shows a relay cable being tested. In another illustration, girls prepare and solder the electrical supply wires to the silver contacts that are used exclusively for the electrical action in these organs. After final tests the cable is taken to the erecting room for its incorporation in the organ proper.

The console or keyboard is an elaborate affair and requires complicated wiring so that the cable may connect the player's keys and stops with the pipes, drummer's traps, et cetera. The parts of the organ are now collected from the various departments and sent to the erecting shop where all organs are assembled and tested electrically, mechanically, and tonally. In the photograph at the top of page 494, several organs can be seen with the pipes on the chests; others show the chests that have not yet received the pipes. In the foreground can be seen a console composed of two manuals or keyboards, with the stop keys arranged in a semi-circular fashion above the top row of keys. The pedal board, which is operated by the feet, can be seen standing in front, ready to be attached to the console. The cable connecting the console to the organ can also be seen coiled on the front of the platform on which the console is standing.

Organs of three and four manuals are usual, and even five and six manuals have been built, but these last without marked advantage in these days of simplified control. Wind at various high and low pressures is conveyed from the blower-room to outlets situated every few yards in the erecting room floor for testing and playing the organs as they are erected. Testing and playing current is similarly distributed to all parts of the erecting room. Freight cars are rolled into the adjoining enclosed shipping room and loaded with the aid of the traveling crane, without exposure of organs or workmen to outside weather conditions.



"RINGING OUT" ON A CONSOLE

Test of wiring before the console goes to the erecting shop to be connected to pipes

One of our photographs shows drums, cymbals and tambourines. These drums and traps are genuine orchestra and band instruments, not merely means of imitating them. In fact, in some instances they are better and more costly than standard instruments, as, for example, the bass and side or snare drums made with automatic spring tension applied to the drum heads to keep them in playing condition through changes in humidity or temperature, an operation performed by the player in an orchestra, who often changes the adjustment several times during a single concert.

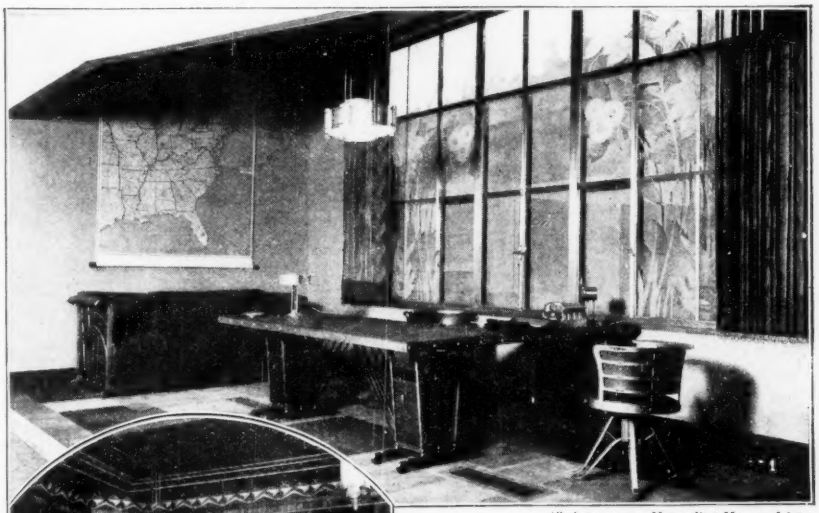
THE tom toms, Chinese gongs, Persian cymbals, and some of the other instruments are imported from the lands where they are the source of native music. Such orchestral elements do not enter into church and residence organ construction, although the harp and chimes of tubular bells are desirable, and are usually found in such organs. Moving-picture houses require all these elements and often many more such as sleigh bells, xylophones, castanets, triangles, glockenspeils, and vibrating bells.

The entire instrument is operated by one musician from a console placed in the orchestra pit or in any location desired. For motion pictures, this is a great advantage, as the operator is able to follow action upon the screen in such a manner as to make it perfectly realistic. In the larger houses the console is often placed on a platform which is raised or lowered by a motor and the orchestra is handled in the same manner.

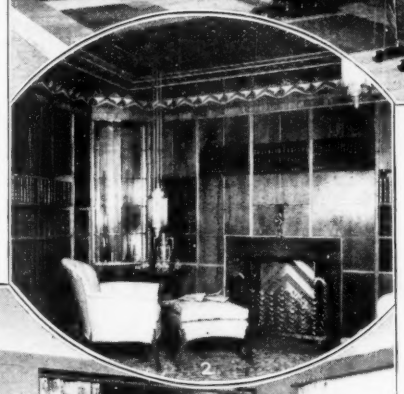
Architects as Room Designers

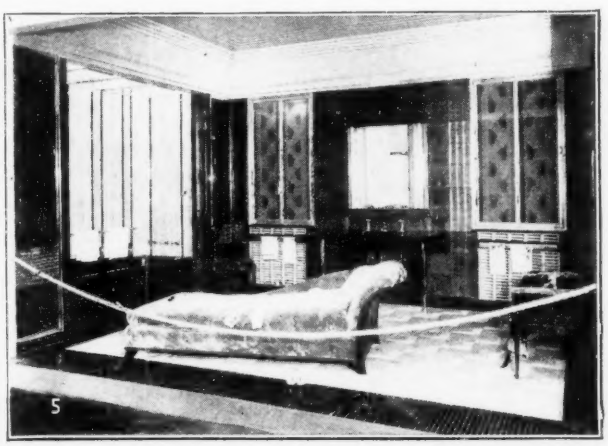
ARCHITECTS have been designing buildings for years, but they rarely go beyond structural features and a good façade. Recently the Metropolitan Museum of Art has afforded nine of the leading architects of the United States an opportunity to show what the architect can do outside of the field which we commonly associate with his profession. These nine leaders in their field functioned as a committee to coordinate their own individual projects. The tangible results are now on exhibition and will be until September, in one of the large galleries at the Museum. Here we have a series of 13 booths, which portray real rooms down to the smallest item. Even the knives on the dining table are designed on a new principle of two thirds handle and one third blade. Every rug, carpet, lamp, telephone, and so on was actually produced from new designs.

We show here four of the 13 rooms. The "Business Executive's Office" (1) by Raymond M. Hood is an innovation. The furniture is made of aluminum, which is ideal, neither shrinking nor warping. The stenographer's chair has a flat arm convenient for the note book. The waste baskets fit into the desk legs. The "Man's Study for a Country House" (2) by Ralph T. Walker accommodates guns and fishing rods as well as books. The lamps traverse the ceiling as well as rise and fall. Any man would be proud of such a room. The "Child's Nursery and Bedroom" (3) by Eugene Shoen was designed to meet the needs of the growing youngster. The furniture is simple, and being constructed of aluminum it is easily handled by the child. It is adjustable so that the pieces may be raised to accommodate the child's growth. The child can paint on the washable walls and can roll out of the low bed without injury. Compartments for everything are provided. The "Bath and Dressing Room" (4 and 5), designed by Ely Jacques Kahn, is most agreeable. The walls are faced with glass. The tile radiator grilles are arranged for hanging bath towels on bars in front of them.



All photos courtesy Metropolitan Museum of Art





The Strangest Thing in Physics*

Why Water at Its Boiling Point Weighs a Little More Than at a Freezing Temperature. Old Concepts, and Even Laws, Are Broken Down by The New Physics

By PAUL R. HEYL, Ph.D.
Physicist, United States Bureau of Standards
Corresponding Editor, SCIENTIFIC AMERICAN

THE scientist sat at his desk reading a letter. He read it through twice, and then, laying it down, looked out of the window in a brown study. This is what the letter said:

"I regret taking up your time, but I am in intellectual trouble. I have been a high school teacher of physics for 35 years, and I have always tried to keep informed as to the progress of science. This has been difficult at times, but I have managed after a fashion.

"Contrary to what you may suppose, it is not the Einstein theory that is troubling me. That seems so strange and bizarre that we may expect almost anything from it, just as we would not be surprised at any erratic behavior on the part of a visitor from, say the kingdom of Prester John. But if one of my fellow townsmen, of established reputation, and whom I have known all my life, should begin to behave strangely, I should be much concerned.

"I learned my physics in the 19th Century, before the discovery of X rays, and I was taught that matter was indestructible. This principle I, with all others of that day, regarded as a main pillar of the temple of science. And now—am I not correct?—I understand that this principle is no longer held to be valid; that matter may actually disappear, be annihilated. This, if true, is to me the strangest thing in physics.

"SURELY such a revolutionary doctrine must be founded upon the very best of experimental evidence; and here I am puzzled again, for I cannot find what this evidence is. All that I can learn seems to indicate that this doctrine is only a theoretical consequence of something in the Einstein theory.

"Now I know that you and others would not have accepted this doctrine unless the evidence for it was satisfactory to you. Please straighten this out for me, for I am really in an uncomfortable state of mind."

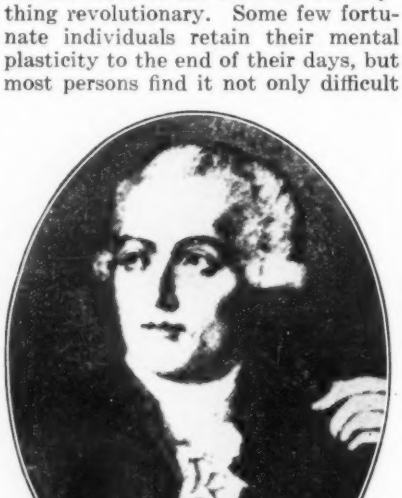
"Thirty-five years!" said the scientist, softly. His own hair was gray. He drew a sheet of paper toward him as though to answer the letter, but stopped and looked out of the window again, pondering a suitable answer.

"I wonder," said he, "how many more such persons there are. Perhaps I had better write an open letter."

And he did. This is it.

MY DEAR SIR:

I can appreciate the difficulty in which you find yourself, for my own student days date as far back as yours. When a man passes middle age it becomes increasingly difficult for him to see the force of the evidence for anything revolutionary. Some few fortunate individuals retain their mental plasticity to the end of their days, but most persons find it not only difficult



LAVOISIER

His work laid the foundations of the principle, long unassailable, but now modified, of the conservation of matter

but distressing to unlearn what was taught them in their youth. Agassiz never could bring himself to accept the doctrine of evolution; and Kelvin found great difficulty in believing that the energy emitted by radio-active bodies came from within the atom.

You are correct in your statement that the principle of the conservation of matter is now regarded as only approximately true. The 19th Century experimental evidence for this principle remains just as good as it ever was. The fact is that the departure from this law is far too small to be picked up experimentally.

You are familiar with the classical experiments of Lavoisier and others; how we may burn something in a closed vessel and find that the weight of the vessel with its contents is, as nearly as we can tell, the same before and after the combustion. You have had impressed upon you that if we take into account all the substances included in a chemical reaction there is, on the whole, no gain or loss in the total mass. You have also learned that there is no change in mass as a consequence of physical changes, such as the heating or cooling of a body, or the change of state from solid to liquid, or liquid to gas.

Modern physical theory declares unhesitatingly that such statements are but close approximations. Just how close they are to the truth may best be understood by a few illustrations.

Water at its boiling point weighs a little more than at a freezing temperature. The difference is about five parts in a million million. For most other bodies the difference is still less.

The freezing of water involves also a slight decrease in mass, amounting to about three parts in a million million. This again is an extreme case, the solidifying of most bodies involving a smaller change in mass.

AS an illustration of the same effect in chemical action, consider the formation of water from oxygen and hydrogen. The weight of the gases before uniting is greater than that of the resulting water by about one part in six thousand million. For most chemical reactions the difference is much less.

Radio-active changes may give rise to greater differences, amounting to as much as one part in ten thousand, but such changes are completed only after long periods of time, of the order of thousands of years.

Such changes are far beyond our ability to weigh. By the greatest of care, and by using comparatively large masses, we may perhaps attain a precision of one part in a thousand million.

At this point you will naturally ask how we can be so precise in our estimates of this very small loss in mass if it so far transcends our ability to weigh it. The answer is that it is a matter of calculation from theory. And permit

*Publication Approved by the Director of the Bureau of Standards of the U.S. Department of Commerce.

me to postpone for the moment any discussion of the foundation of this theory until I have explained its nature.

In each of the cases that I have mentioned, whether physical or chemical, there was an evolution of energy. The hot water cooled down, radiating away heat. The freezing water gave out its latent heat of solidification. The explosion of hydrogen and oxygen liberates more heat than most chemical reactions, and the continual development of heat in radio-active bodies was an experimental fact that sorely puzzled Kelvin.

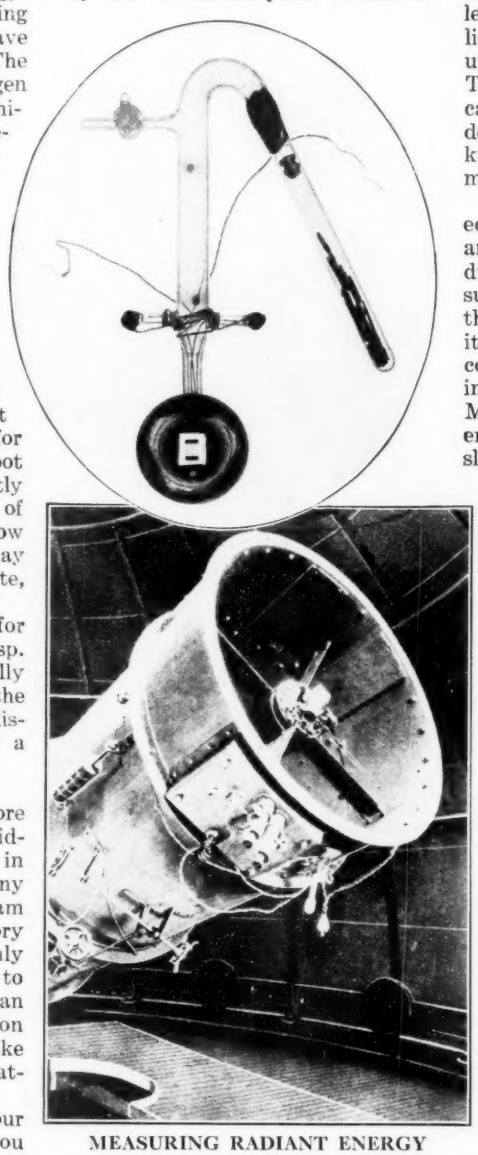
Modern theory states that in every case of a loss of energy there is a proportional loss of mass. It seems that energy itself possesses a little mass which it carries off with it when it leaves. This mass equivalent of energy must be regarded in very much the same light as we regard the heat equivalent of energy. It has been recognized for about 70 years that for every 778 foot pounds of work that may apparently disappear, one British thermal unit of heat makes its appearance. We are now accustomed to the idea that work may be converted into heat with a definite, fixed ratio.

But this was a difficult concept for the physicists of other days to grasp. And we of today are finding it equally difficult to accustom ourselves to the idea that mass may apparently disappear, to reappear as energy in a definite ratio.

OUR problem is somewhat more difficult than that of the mid-Victorian physicist, for the ratio in this case is very small. It takes many more units of energy to equal a gram of mass than it does to equal a calory of heat. As a matter of figures, only 4.2×10^7 ergs of work are required to make a calory, while no less than 9×10^{20} ergs (about 20 million million times as many) are necessary to make up the equivalent of one gram of matter.

A simple calculation, which your knowledge of physics will enable you to make readily, gives the changes of mass which I have stated to occur in each case which I have cited.

It may perhaps suggest itself to you that in the astronomer's laboratory we might find instances of loss of mass which would be large enough to measure, such as the radiation of heat by the Sun. It is true that the total heat radiation of the Sun is enormous, but 9×10^{20} is a very large number, too. Calculation, however, tells us that the Sun is losing mass by radiation at the rather surprising rate of four million tons per second! This, however, is not so easy to detect as might appear. The only way we have of detecting any change in the Sun's mass is by an alteration in his gravitative pull on the Earth and the other planets. This pull is due to the whole mass of the Sun; and, large as four million tons per second may appear in itself, the Sun's total mass is so super-enormous that only after 10 million years at this rate



MEASURING RADIANT ENERGY

Top: A vacuum bismuth-silver thermocouple devised by Dr. W. W. Coblentz of the Bureau of Standards. The dark material inside the tube is metallic calcium to absorb traces of residual gas. Bottom: The same thermocouple in place on the Lick reflecting telescope. Courtesy Lick Observatory

of expenditure would his total mass (and his attraction) be reduced by one millionth!

We are therefore at present without any experimental means of checking theory. Nevertheless, I and others accept this theory, and the reason for this I will now try to make clear.

It is a fact, as you mention in your letter, that the doctrine of the equivalence of matter and energy was first announced by Einstein as a mathematical deduction from his theory of relativity; but within a short time he saw that this new doctrine had also a purely classical basis which carried it back to Maxwell and even to Newton. You and I, sir, found Maxwell's doctrines already classics when we were in college. One of these doctrines was that light will exert a very small pressure upon any surface which it encounters. The amount of this pressure as indicated by theory was too small to be detected in Maxwell's day, but, as you know, it has since been observed and measured by several experimenters.

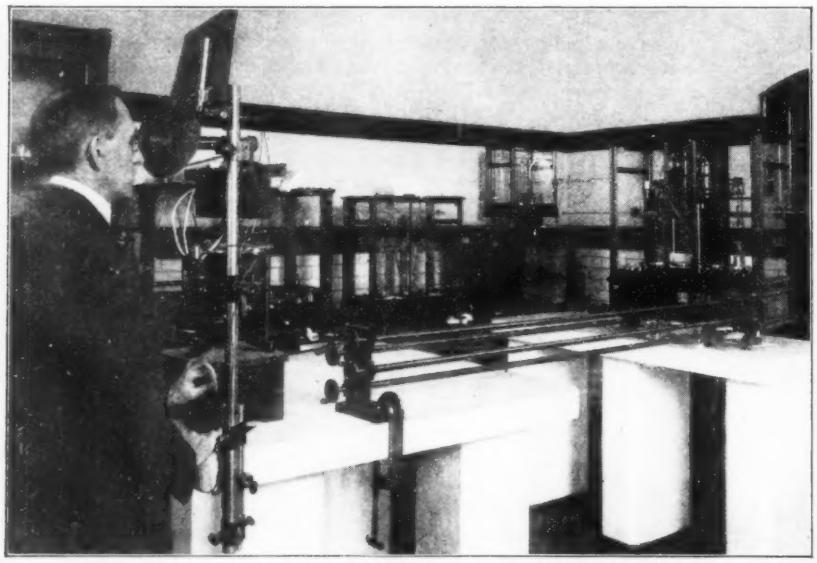
We must now remember Newton's equally classical principle that action and reaction are equal and in opposite directions; that if a body exerts pressure when we try to stop it, it will by the same token require a force to start it, and that there will be a kick or recoil of the pushing mechanism. Joining these two principles of Newton and Maxwell, we conclude that anything emitting a flash of light will recoil slightly as the light leaves it. In other words, light energy behaves just as though it possessed a little mass.

Now, while the pressure of light upon a receiving surface has been measured, the recoil of the emitting source has not yet been experimentally observed. The difficulties are still too great. Yet no one who accepts the classical mechanics can doubt the existence of such a recoil. It seems strange that Maxwell did not think this far. He pointed out the existence of light pressure at the receiving end, but it remained for Einstein, a generation later, to complete the theory by discussing what happens at the emitting end. In other words, Maxwell recognized that light possessed momentum, but Einstein was the first to show that it also possessed inertia. It is for this reason that this new idea is sometimes called the inertia of energy.

RADIANT heat, as you know, is of essentially the same nature as light, the only difference being one of degree. Its wavelengths are too long and its vibrations too slow to affect the eye. All that has been said of light must hold good for radiant heat. Maxwell's theory of light pressure is in no wise dependent upon the wavelength. It follows then that radiant heat must possess a little mass, to this extent behaving like a moving particle.

Let me here remind you of the very recent theory of wave atoms, which seems to be carrying us toward some kind of a union of the wave and particle concept.

Einstein summarizes his whole argument as follows: either we must admit the equivalence of mass and energy or we must abandon the whole structure of classical mechanics.



"HE MUST HAVE A LONG SPOON WHO EATS WITH THE DEVIL"

In precision weighing, the operator stands at a distance to avoid the effect of heat of the body. Note four long operating rods. The scale is read by means of a small telescope

Now you and I, sir, as scientific men, should be perfectly willing to abandon an old theory if we see any reason to do so, and we have actually done this many times. Our retention of the classical mechanics is not due to conservatism, but to the fact that the experimental evidence on which it is based is still perfectly good. Thus the new theory of the equivalence of mass and energy, for the lack of a ticket of its own, rides into acceptance on the lap of the older doctrine, which refuses to part with its child, and will, in fact, rather get off the train.

On this basis you will see that the doctrine of the mass equivalent of energy is independent of the theory of relativity. If the theory of relativity supports this doctrine, so much the better for relativity; it gains strength rather than imparts it.

But it may now suggest itself to you that I have told but half the story. I have mentioned various instances where bodies have lost mass because they have lost energy. What about bodies that gain energy? Does their mass increase?

YES, we must go the whole logical way. If energy in leaving carries away a little mass, then energy in returning must bring it back. If cold water weighs less than hot water, then hot water must weigh more than cold. If the water resulting from the combination of oxygen and hydrogen weighs less than its component gases, these gases must weigh more than the water formed from them. The merest child who is old enough to set a kettle of water on the stove may be said to have created a little mass; and the decomposition of water by an electric current involves a similar increase of it.

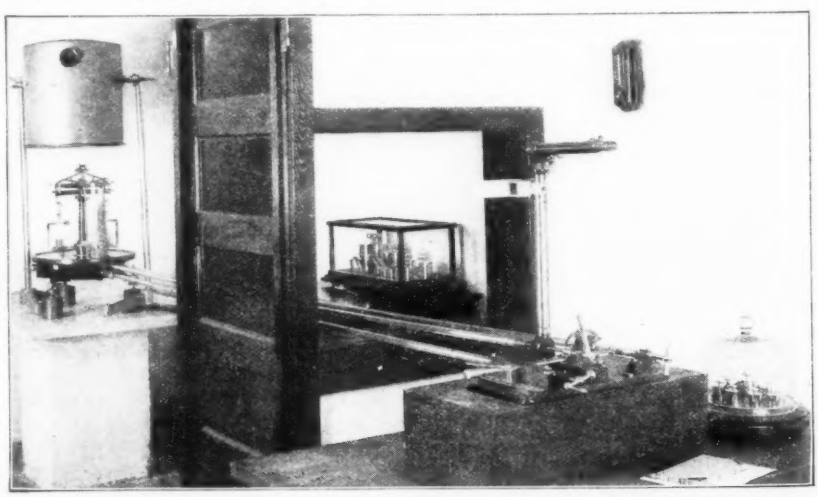
Another curious aspect of this principle is found in the case of lifted weights, which according to the older mechanics, possessed increased potential energy by virtue of the work that had been done upon them. We say now that the lifted weight is a little more massive. The rather vague concept of potential energy has become a definite, weighable quantity.

I can appreciate, sir, to the full the wrench that the effort to accept such a doctrine must give your feelings; but let me now apply to your hurts a salve that I have found beneficial in my own case. The old doctrine of the conservation of matter is no longer to be accepted as strictly true. Small as are, the departures from it in our present experience, if continued long enough they may become very large. In a million million years the mass of the Sun will be but a fraction of its present amount. The old doctrine is gone, but a new and more general one stands ready to take its place. Matter disappears as such, only to reappear as energy. There is neither creation nor annihilation, merely a change of form, such as we have long been familiar with in the principle of the conservation of energy.

In place of the older principles of the conservation of matter and of energy we have a new and more inclusive principle of the conservation of what we may call "matter-energy." Two concepts have been replaced by one; matter and energy are henceforth to be regarded as particular aspects or special cases of this new and broader concept for which we lack as yet a suitable name.

The unification of our ideas about Nature goes on apace. This reduction of two mysteries to one is but another step in a process with which you, as a student of physics, are doubtless familiar. All through the 19th Century and into the 20th, we find this process repeated many times. At the beginning of the last century visible light, radiant heat, and the invisible photographic rays were regarded as separate entities. Now the three are one, and to them have been added at one end of the spectrum the long waves of radio communication and at the other the X rays and the cosmic rays. Maxwell correlated the two concepts of light and electricity; Ohm and Faraday those of electricity and magnetism. And finally, in the 20th Century, Einstein, in addition to correlating gravitation and inertia, showed that matter and energy are but two different sides of the shield.

THE trend of the times is unmistakable. We must go along or be left behind. And I hope, sir, that this little effort of mine may enable you to keep us company with a clear conscience.



A DELICATE VACUUM BALANCE AT THE BUREAU OF STANDARDS

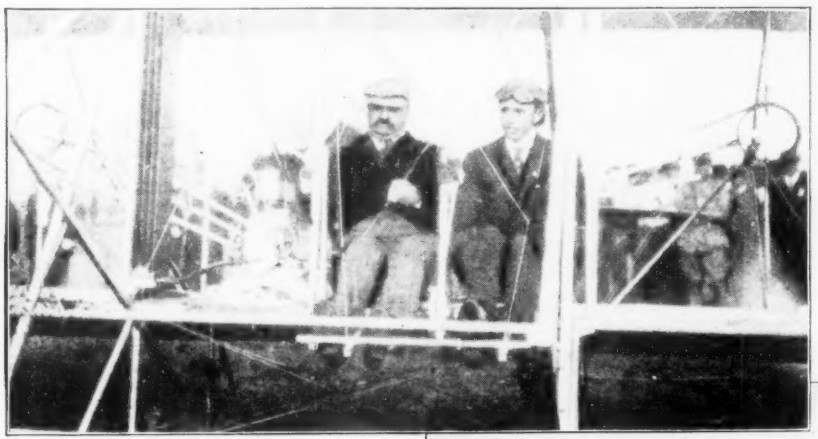
The cap is raised to show the balance. When lowered, it forms an air-tight joint at the bottom, permitting the air to be exhausted from the balance. All manipulation is by rods

"Firsts" in Aviation

AS we look back through 25 years and more of aircraft development, we find along the way certain highlights which serve to indicate the progress of the art. The first and only president of the United States to fly; the first and only woman ever to test an airplane for the government; the first dual control to be installed in an airplane; the first government dirigible; the first time a battleship acted as mother craft to an airplane; these are the subjects which we illustrate on this page. The photographs are from the files of Elizabeth H. Gregory, reporter and feature writer.

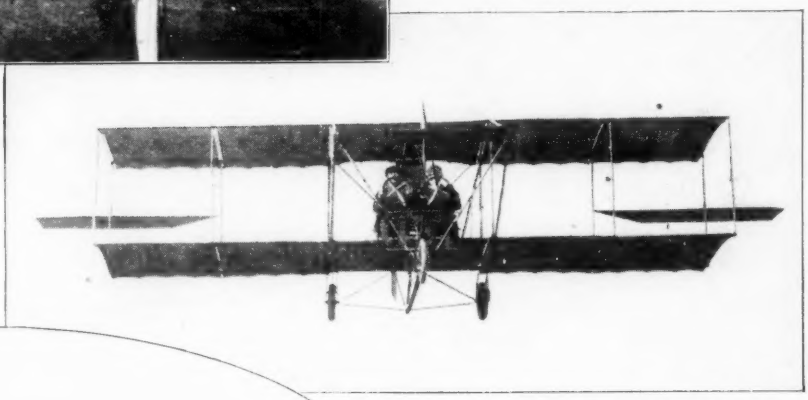
▲ BERNETTA MILLER

Miss Miller was the only woman to make a test flight for Uncle Sam. In 1913 she piloted a Moisant monoplane



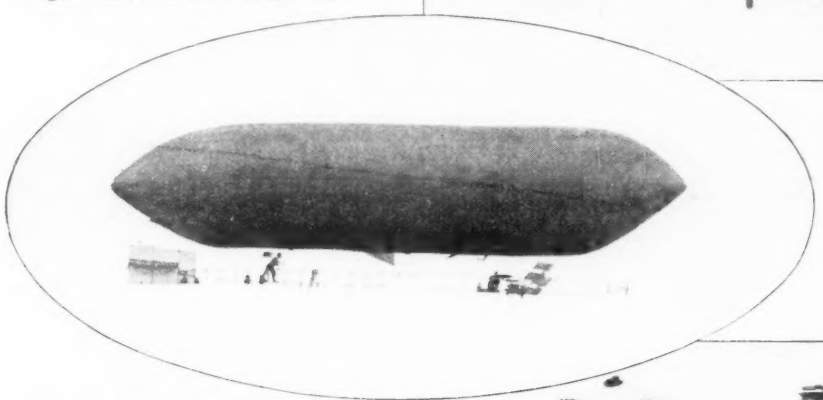
▲ "TEDDY" FLEW

Recently a controversy arose as to whether the president of the United States should fly if he so desired, and statements were made that never in the history of aviation had a president gone aloft. Here, however, is pictorial evidence that one president, at least, has braved the upper air. In 1910, the late president, left, flew as a passenger with Hoxie in a Wright biplane



▲ FIRST DUAL CONTROL

In the early days of flying, students were told all about it on the ground, given a few flights and then told to "go to it." They first guided the ship around the field on the ground, and then took short "hops," gradually increasing the height. In 1911, Glenn H. Curtiss installed the first dual control; instruction methods changed



DIRIGIBLE NO. 1 ▲

In August, 1908, Captain Thomas S. Baldwin delivered this 120 foot dirigible balloon, the first one ever ordered, to the United States Government. It was named *Dirigible Balloon Number 1*, and carried one passenger and pilot. It was designed for scouting purposes

BATTLESHIP PLANE ➤

Some of the present-day feats with up-to-date planes may not seem so thrilling when we consider that, in 1911, with a crude machine, Eugene Ely landed on the deck of a battleship and later took off from the same place

Work Progresses On Mightiest Bridge

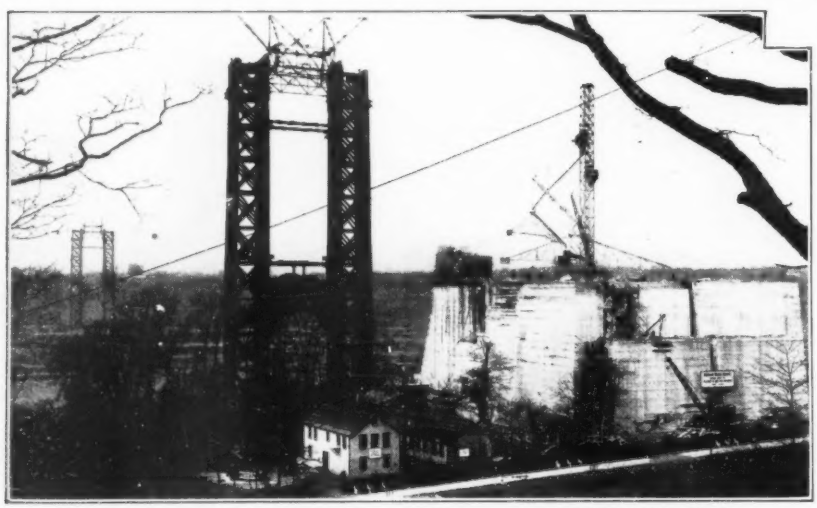
Hudson River Span Is Scheduled for Completion in 1932. The Towers are Rising Rapidly

STANDING prominently out against a background of apartment houses on the east, against the Palisades on the west, and against a majestic sweep of river, north and south, two massive steel towers are nearing completion in the Hudson River opposite uptown New York City. These towers, which are higher than the Washington Monument, are to support the world's greatest bridge, a bridge that is to solve, to a great extent, the problem of traffic movement between New York and New Jersey. Consequently, it will provide quicker access to Manhattan for countless thousands of motorists.

Besides the towers, each of which will carry at the top a cable load of 112,500 tons and which are later to be encased in concrete and granite masonry, other works, less visible to the distant or casual observer, are proceeding rapidly. The massive concrete and steel anchorage on the Manhattan side was completed in March, three months ahead of specified time. The extensive tunnel operations necessary at Fort Lee for the New Jersey anchorage, are likewise finished. During the past winter the excavating for the New Jersey approach was virtually completed, elevators were installed in the towers, preparations were made for erecting the cables—scheduled to be begun during the coming summer—and other incidental details were taken care of. The tower elevators are for the use of the erectors at present but when the bridge is completed, new cages will be installed so that the elevators may be used by the sight-seeing public.

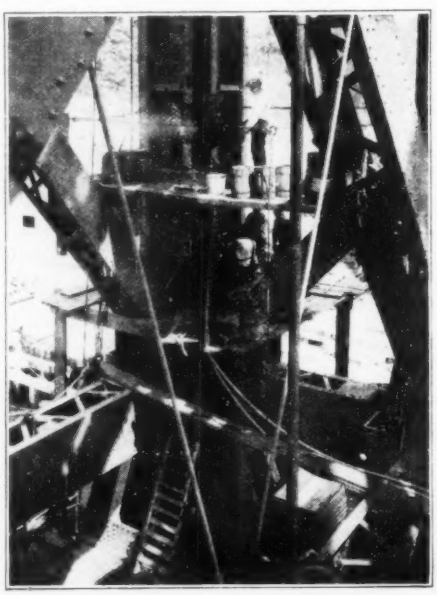
STEEL IN NEW YORK ANCHORAGE

The wire cables will be attached to the steel shown, which was later imbedded in concrete



TOWERS AND NEW YORK ANCHORAGE IN FEBRUARY, 1929

This concrete block, which is to be faced with granite, is the largest of its kind in the world; compare with contractor's two-story frame house. Riverside Drive is in the foreground



800,000 FIELD-DRIVEN RIVETS

About that number are in the two towers. Here a splice in a tower is being riveted

By the end of 1927, the two large cofferdams for the New Jersey tower foundation had been completed and the placing of concrete within them started. Upon removal of the overburden of earth, the rock was found to be, throughout, of solid sandstone of varying degrees of hardness and of very rugged surface. This was fortunate because the natural steps formed an excellent bond with the concrete so that little blasting was necessary. The concreting proceeded rapidly. About nine feet below water level, the granite facing was begun and thereafter kept pace with the concreting. This foundation work involved 75,500 cubic yards of dredging, and placing of 35,480 cubic yards of concrete, 1400 cubic yards of granite, and 300 tons of reinforcing steel.

THE New York tower rests upon a rocky point and consists of two piers or bases, one under each leg of the tower. Each base extends slightly beyond the water line so that only shallow, simple cofferdams were necessary to exclude the water. Only 7300 cubic yards of rock excavation and placing of 9700 cubic yards of concrete were involved here.

The roadway on the upper floor of the bridge will intersect the rock face of the Palisades about 50 feet below their summit and the lower floor will be about 35 feet below this level. Thus the New Jersey highway approach consists of an open cut through the Palisades for a distance of 750 feet. When completed, it will be 146 feet wide at the roadway and will have involved the removal of 220,000 cubic yards of rock.

The New Jersey anchorage tunnels, which are of such size that they could accommodate four trolley tracks on

each of two levels, are below the lower level and at the end of inclined shafts. In these tunnels, the 61 strands of each of the cables will be spread out, finger-like, and fastened to eyebars connecting to anchorage girders set in concrete. Eyebars, chains, girders, and concrete will completely fill the tunnels.

Perhaps the most interesting part of the work thus far is the construction of the massive concrete block which will serve for anchoring the cables on the New York side. Since each cable is to be made up of 26,474 double-galvanized, high strength, steel wires, each .192 of an inch in diameter—making a total diameter for the cable of about 36 inches—the weight of the cable alone would make a huge anchorage necessary. Add to this, however, the weight of the bridge structure, the estimated traffic load, and a large safety factor and it will be seen that only a miniature mountain of concrete would suffice as an anchorage.

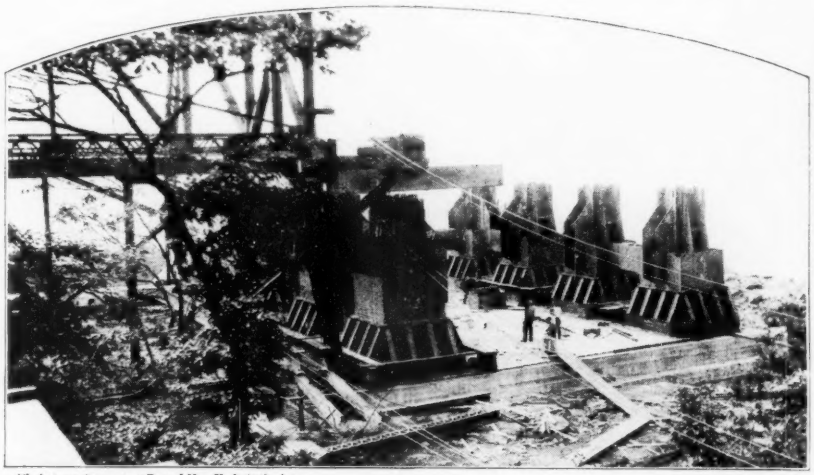
The concreting of this anchorage constitutes completion of only the first stage of the work. Later, certain concrete backing which was omitted, and all granite facing, will be constructed. The anchorage will represent, when fully completed, a gigantic masonry block about 200 feet wide, 290 feet long at its base, and 130 feet high, resting on solid bedrock.

Construction of an extensive dock on the river shore south of the New York tower was necessary for unloading sand, gravel, and cement. Two belt conveyors carried materials a distance of 850 feet to the mixer plant. Two one-yard concrete mixers discharged into a hopper which controlled the flow to a high speed conveyor belt. This belt carried the mixed concrete to another hopper at the base of the concreting tower which was 265 feet high. From this tower, concrete was distributed by means of a counterweight chute capable of movement over a wide area.

Twenty heavy girders and 976 eyebars were imbedded in the concrete after having been given three heavy coats of red lead paint. This first stage of the anchorage work involved the excavation of 16,000 cubic yards of rock, the pouring of about 110,000 cubic yards of concrete, and the setting of about 2500 tons of steel reinforcement and cable tie work.

It is a far cry from the day, a little over a hundred years ago, when Thomas Telford finished, in Wales, what was then the world's greatest suspension bridge which had a 503-foot span. The Hudson River bridge with its 3500-foot span will eclipse not only this famous structure but also all succeeding ones by a large margin. And while the new monster bridge is not likely to be ranked throughout the ages as the eighth wonder of the world, as was predicted for Telford's, it will surely stand as the world's greatest bridge for many years to come.

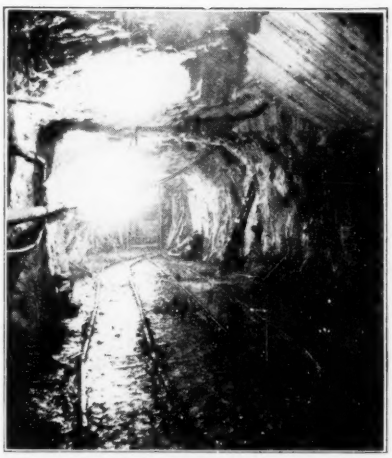
¶ *A 600 or 800-mile pipe line for carrying oil? Impossible, you say? Not at all. They're economically practicable projects, as oil producers have learned by experience. An article on the subject is coming in an early issue.*



All photographs courtesy Port of New York Authority

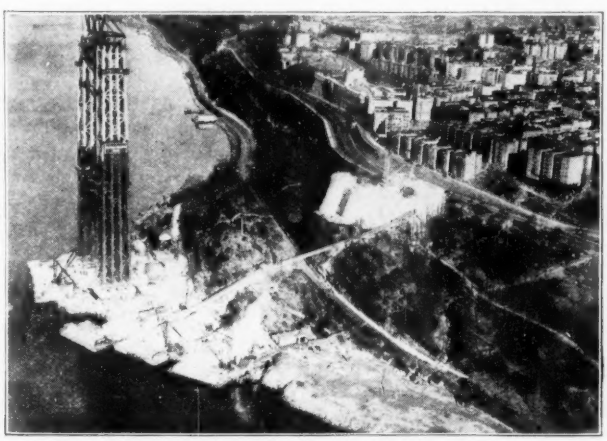
COLUMN BASES OF A TOWER LEG IN PLACE

Each of the two legs of each tower contains eight columns. In this photograph of the New York tower, the relative size of their bases may be noted by comparison with the workmen



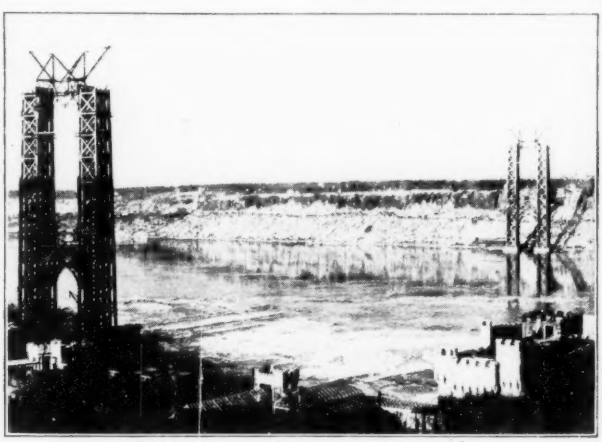
NEW JERSEY ANCHORAGE TUNNEL

One of the tunnels, cut in solid rock, into which cables will extend and be tied



MANHATTAN IN THE BACKGROUND

Anchorage and towers on the New York side. The anchorage stands as a mountain of concrete before the city apartments



THE PALISADES LOOMING CLEAR AND COLD

The two towers as seen from the east. When completed, visitors will be whisked upward in elevators for a splendid view of the city

The Highest Known Velocity

Astrophysicists Have Just Determined that One Universe of Stars Is Moving Through Space at Five Thousand Times the Speed of a Rifle Bullet

By HENRY NORRIS RUSSELL, Ph.D.

Chairman of the Department of Astronomy and Director of the Observatory at Princeton University
Research Associate of the Mount Wilson Observatory of the Carnegie Institution of Washington

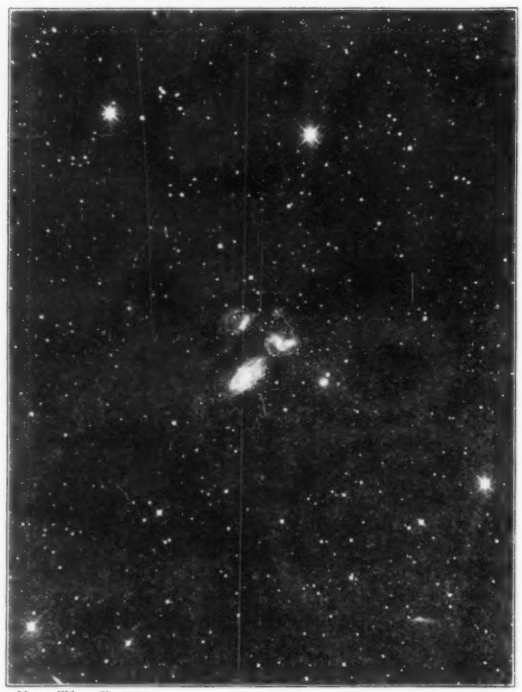
TWO unusually interesting items of astronomical news have just appeared in the "Communications from the Mount Wilson Observatory." The first, by Mr. Milton Humason, deals with spectroscopic observations of a faint and probably very remote nebula.

On the borders of Aquarius and Pisces there is a cluster of small spiral elongated and globular nebulae. The brightest of them, which is known as N. G. C. 7619 because it bears this number in the "New General Catalog" of nebulae, was observed with the 100-inch telescope and a photographic spectroscope especially designed for the study of very faint objects. The photographed spectrum is only a quarter of an inch or so long, yet so faint is the light that to obtain the two successful plates, exposures of 33 and 45 hours were required; working all night, shutting up the apparatus light tight, and then starting again the next clear night till the long task was completed.

THE resulting spectra resembled roughly that of the Sun—as might be expected if this remote nebula, like many nearer ones, is a huge swarm of stars far too remote to see separately—but the lines in the spectrum were at first barely recognizable, for none of them were in the familiar places. Measures showed, however, that they were the familiar solar lines enormously shifted toward the red.

Such a shift would be produced by a rapid recession of the nebula, but when the corresponding velocity was calculated it came out at 3800 kilometers or nearly 2400 miles per second! This is great quite beyond precedent, the largest motion previously known being 1800 kilometers per second—also for a faint nebula and likewise one of recession. The correctness of this remarkable result is checked by the agreement of the two plates within 2 percent, and there can be no doubt of its substantial accuracy. Observations on other faint nebulae are under way, and within a year or two we shall know whether these too are moving at equally great speeds.

Along with this noteworthy observation comes an important piece of theoretical discussion by Dr. Hubble, whose pioneer work on the distances of the Andromeda nebula is well known. By similar methods he now gives the distances of 24 nebulae. All but five of them, when photographed with the 100-inch telescope, show the brightest at least of the separate stars of which they are composed, and knowing how bright these appear, the distance can be estimated. Four others belong to the great cluster of nebulae in the constellation Virgo, whose distance can be found on the assumption that the average brightness of the nebulae in it is the same as that of the nearer nebulae previously studied. Finally, one small, bright nebula appears to be in reality as well as in appearance a companion to the Andromeda nebula.



Mount Wilson Observatory

THREE INTERESTING SPIRALS

These are N.G.C. 7317, 7318, and 7319, photographed in eight and one half hours with the 60-inch reflector

The table of distances which Dr. Hubble gives is at first glance surprising. It is remarkable to see the distance of the large Magellanic Cloud listed as "0.034," and that of the Andromeda nebula as "0.27." Since the nebulae as a whole are so remote, it has been found best to adopt a new unit of measurement which some people call a "megaparsec." This corresponds to a million parsecs, or 3,260,000 light-years, a parsec being 3.26 light-years. Translated with this aid it appears that the Magellanic Cloud is 110,000 light-years off and the Andromeda nebula 840,000. These values are by this time familiar, but the next nearest nebula is at 1,500,000 light-years. Then follow a dozen with distances varying from 1,600,000 to 4,500,000 light-years, while the Virgo cluster appears to be at 6,500,000, which, great as it is, is less than Shapley's estimate of 10,000,000 light-years.

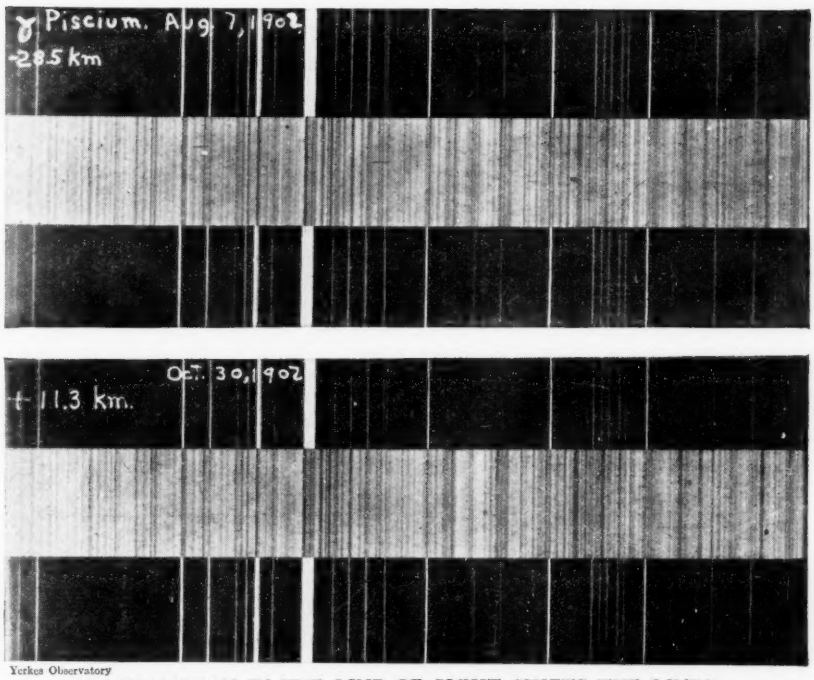
FROM these distances the brightness of each nebula can be found. The variation among them is a hundred fold. The faintest gives out 10,000,000 times the Sun's light and the brightest is a billion times more luminous than the Sun, doubtless by the combined light of hundreds of millions of stars.

These data alone would make the paper noteworthy, but Hubble's main point involves a comparison of the distances of the nebulae with their spectroscopically observed velocities. A mere glance at his table shows that the remotest nebulae have the most rapid motions and (as has long been known) that all of them are receding from us. This suggests that for some reason or other, the speed of a nebula is nearly proportional to its distance.

Before this can be fully tested we must take account of the probability that the Sun is itself in motion. A simple calculation verifies this assumption. It is found that, compared with the general average of the nebulae, the Sun is moving about in the direction in which the bright star Vega appears in the sky and at the rate of 280

kilometers a second. Allowing for this, the remaining motions of the nebulae show a very pronounced "distance-effect," proportional to the distance and amounting to 500 kilometers per second at a million parsecs. The outstanding velocities of the nebulae, after this effect is allowed for, drop to the relatively low average of 150 kilometers per second, which may reasonably be attributed to the random motions of the individual bodies.

This conclusion that the nebulae are receding from the Sun in all directions, at rates proportional to the distances, is so remarkable that confirmation is desirable; and Hubble has such evidence to offer. First, there are 22 other nebulae for which the radial velocities are known, but not the distances (since no stars have been observed in them). Their average distance can, hovever, be computed from the average brightness and comes out 4,500,000 light-years. The average observed velocity of recession is 745 kilometers per second—almost exactly what is predicted by Hubble's formula, which was derived from a quite different set of nebulae.



Yerkes Observatory

HOW MOTION IN THE LINE OF SIGHT SHIFTS THE LINES

This shows effect of the earth's revolution around the Sun: in August the motion with respect to the star Gamma Piscium was greater (more shift to the right) than in October

FROM the observed rates of recession of these nebulae it is then possible to estimate the distances (by ignoring the effects of their random motions). The results range from 2,000,000 to 11,000,000 light-years and should be good on the average to a million light-years or so.

The same method applied to Humason's fast moving nebula gives a distance of 25,000,000 light-years. The distance of the cluster of nebulae to which it belongs can be estimated quite independently from their average brightness (assuming as is reasonable that their real brightness averages the same as that of other nebulae) and comes out 23,000,000 light-years.

The existence of the strange "distance effect" appears therefore to be conclusively proved. If it continues to be proportional to the distance for still remoter nebulae, their spectra would be very strange. A nebula ten times as far away as Humason's could still be easily photographed as an object of the 17th magnitude, and for this we might expect a velocity of nearly 40,000 kilometers per second. This would shift the sodium lines from the yellow part of the spectrum far into the red! The chance of photographing the spectrum of so faint an object with existing instruments appears to be very small, but velocities a good deal higher than have yet been observed should be attainable.

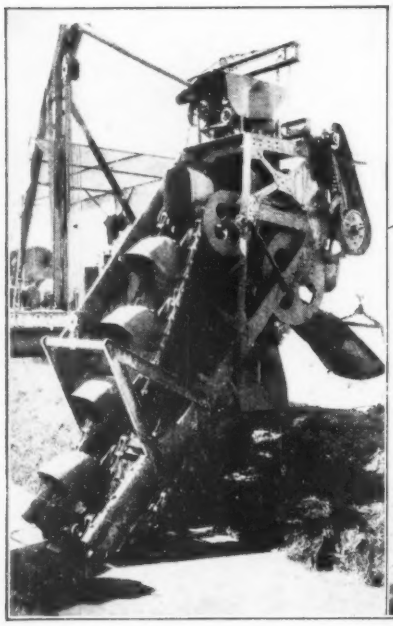
By this time, however, the reader has probably long been asking, "What does this all mean? Are the nebulae really flying out in all directions—away from us and therefore from one another—so that the universe of nebulae is expanding without limits into the depths of space?"

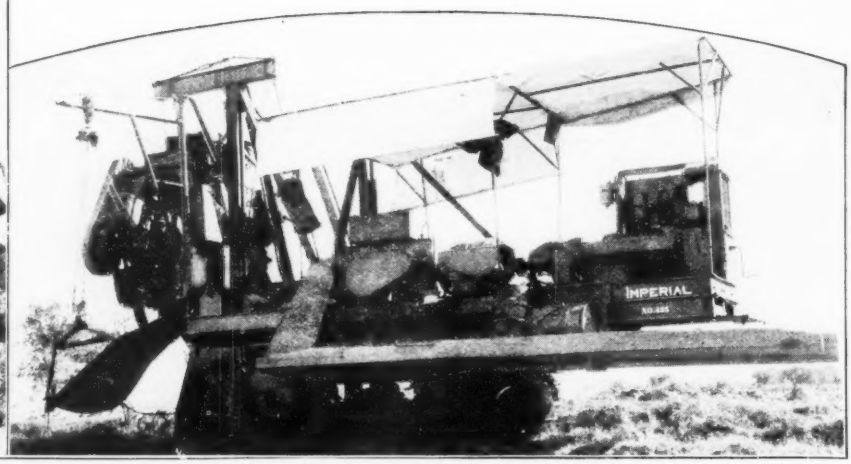
This is a hard problem to solve. The best answer that has yet been suggested comes from a peculiar form of the theory of relativity suggested a few years ago by the great Dutch astronomer de Sitter. This theory, while consistent with Einstein's general ideas, differs from his formulation in detail. Mathematically it is characterized by great elegance; practically, it leads to very strange results. For the remarks which follow, the writer is greatly indebted to a brilliant résumé by Prof. Tolman: In any "small" part of space not more than 10,000 light-years in extent, de Sitter's theory leads to the same results as Einstein's now familiar theories. But in a larger view, space and time have unexpected properties.

ONE difference, in particular, concerns us at this moment. According to the conceptions of Einstein, as well as of Newton, the "nature of things" is such that two material particles at rest in space relative to one another and at a great distance will remain at rest except for the very slow motion due to their mutual gravitation. But from de Sitter's equations it follows that the nature of things is such that any two (or more) particles will automatically start to move away from one another as if they repelled one another with forces increasing with the distance. At such distances as those of the planets from the Sun this effect is negligible and gravitation reigns supreme. But at the distances of the nebulae the reverse is the case. Material bodies like nebulae in a "de Sitter world" will therefore scatter ever more and more widely and recede from one another faster and faster. If originally (that is at the time when we start to think about them) they were fairly close together, they will, after the lapse of ages, be receding from one another with speeds proportional to their distances, just as Hubble's investigations indicate.

IT would be premature, however, to adopt de Sitter's theory without reservation. The notion that all the nebulae were originally close together is philosophically rather unsatisfactory. One asks why, and finds no answer. Meanwhile de Sitter's holds the field. When pushed to the limit it predicts things still more extraordinary than other relativistic theories, culminating in the disappearance of time altogether from the mathematical equations. But this would happen only at a gigantic distance, which from Hubble's data would come out 600 million parsecs or two billion light-years; so that these mathematical curiosities are not of present concern. Indeed they can never be so, for it can be shown from de Sitter's equations that a moving particle or even a ray of light would (in a certain sense) slow up its motion before it reached this critical distance and never quite get there in any finite interval of time. This justifies the picturesque remark of the inventor of the theory, that its more extraordinary consequences "could only happen before the beginning or after the close of eternity!"

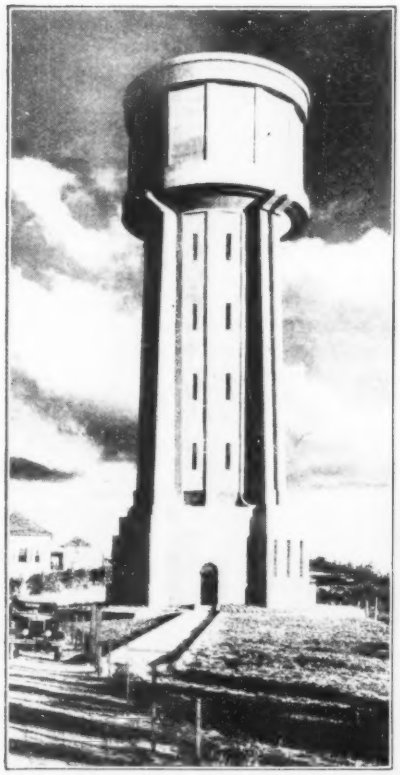
From the Scrap-book of Science





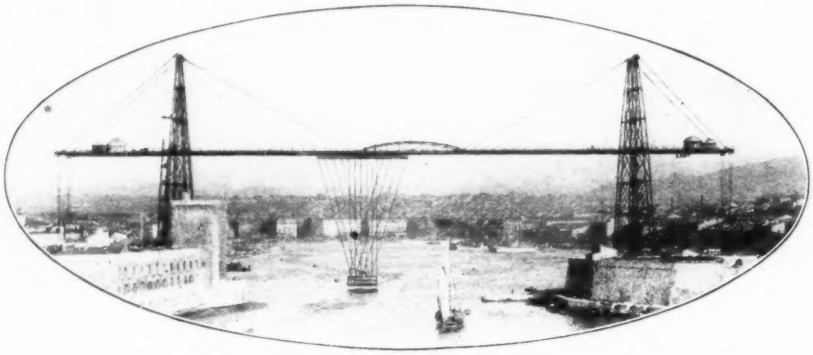
A NEW ENEMY OF SILT AND VEGETATION

The Imperial Valley of California has become one of the most fruitful areas of the country due to its extensive irrigation system. A great deal of silt, however, comes into the canals and ditches from the Colorado River, settles and retards the flow of water, and has to be removed. Above, at the left, is shown the business end of a new dredging machine which has been developed by the Imperial Valley Irrigation District under the direction of W. O. Blair and L. A. Graves. At the right is shown the discharge side. The buckets on an endless chain scoop out silt and scrape vegetation from the banks of the canals as the machine travels on the top of the embankment



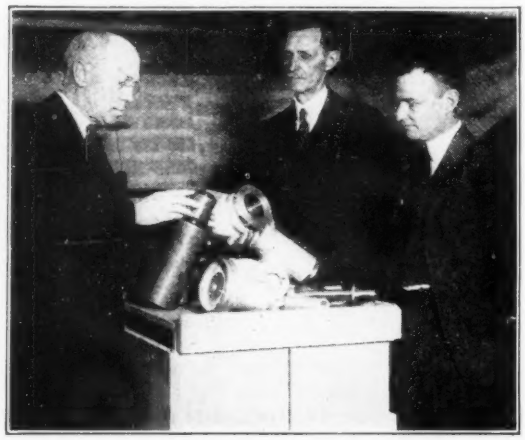
COLOSSAL AIR GUIDE TANK

A revolving light on top of this 210-foot water tank recently completed at Nassau in the Bahamas, will serve to guide the air liners of the Pan-American services. An elevator carries visitors to the top platform



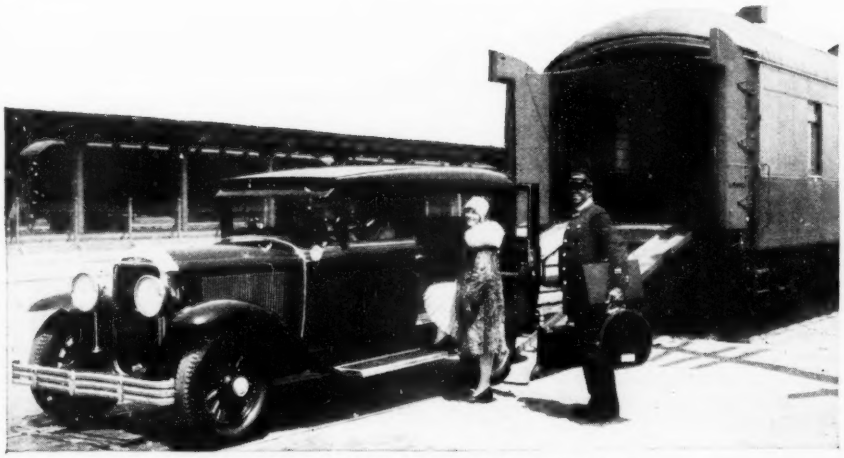
NOT A BRIDGE BUT A HIGH AND DRY FERRY

This structure, while giving the impression of a partly completed bridge, is a crane ferry at Marseilles, France. It is one of three in the world, the other two being at St. Paul, Minnesota, and Rio de Janeiro, Brazil. The passenger and traffic-carrying car moves back and forth suspended near water surface from a track 780 feet long. Note cables necessary for holding down the projecting ends



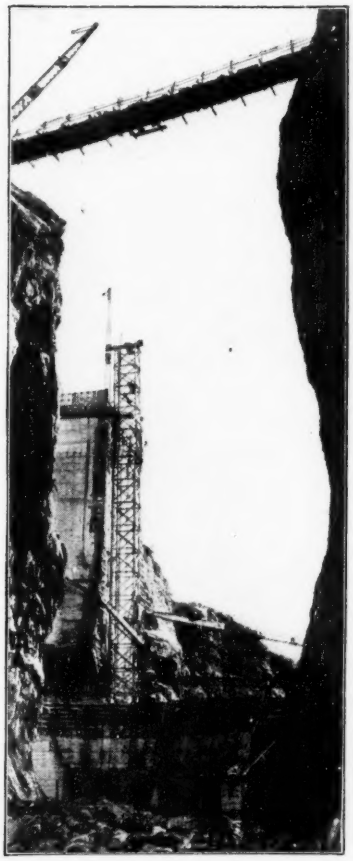
OPTICAL WIZARD OF THE GREEN MOUNTAINS

Russell W. Porter (at left), the Vermont genius who has been called in to help design a great 200-inch telescope for the California Institute of Technology and Mt. Wilson Observatory. Because of his versatility as designer of telescopes and other apparatus, as a mechanic, artist, architect, and composer of music, he has often been compared with the versatile Leonardo da Vinci. With him are amateur telescope makers Hicks and Mergenthaler



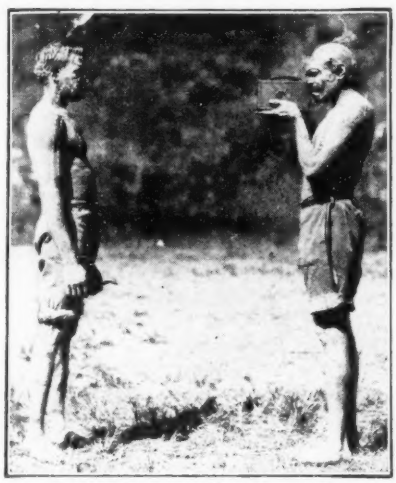
NOW THE FAMILY CAR CAN RIDE TOO

For the motorist who dislikes driving over the rugged mountains between San Francisco and Del Monte, yet who wishes to make the trip and have his car for use at his destination, the Southern Pacific Railroad has adopted this end-entrance automobile car. The automobile is driven up a special runway, is checked like ordinary baggage, shipped, and then unloaded under its own power



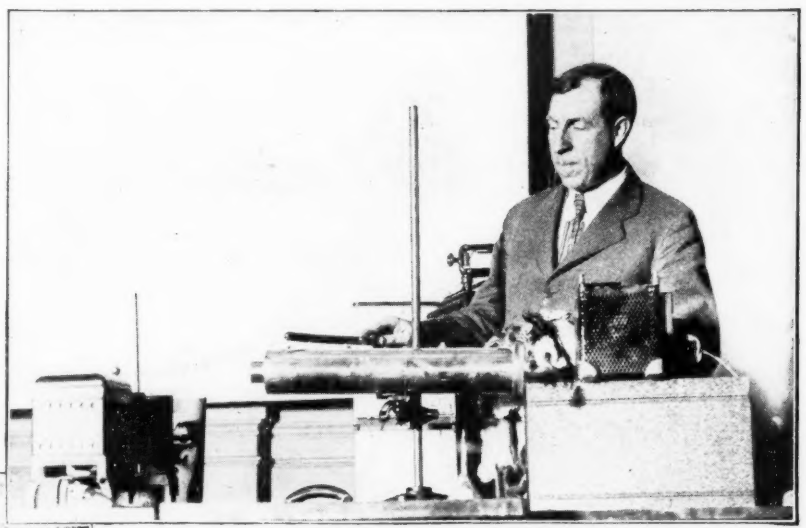
A HIGHER DAM ➤

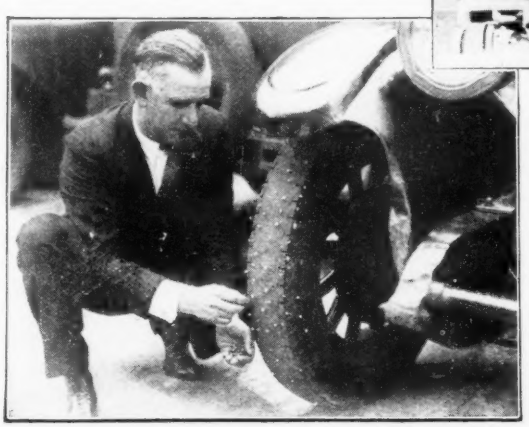
Diablo Dam, 386 feet high—10 feet higher than Pacoima Dam, at present the world's highest—is nearing completion and will soon take its place as the second unit in Seattle's 30,000,000-dollar hydro-electric development on the Skagit River in the Cascades. It will be 150 feet thick at the base and 18 feet at the top; 1195 feet long; and of the constant-angle arch type. It will impound 90,000 acre-feet of water for generating 140,000 horsepower



WATCH FOR THE BIRDIE!

Question: Have we here a new star in the "movie" firmament? No; just a couple of the boys—aborigines of the Palm Islands near North Queensland, Australia, with scarified flesh, painted and top-knotted according to tribal custom, taking a few shots with a new "weapon:" an amateur motion picture camera





➤ A PESKY WEED DID IT

In the west this so-called "puncture weed" is spreading rapidly, especially in the Santa Clara River Valley. The St. Francis Dam flood is said to be the primary cause of this. Last year strenuous efforts were made to eradicate it and if it is not stamped out, farmers as well as motorists will suffer great losses. The weed has spear-like thorns which work farther into a tire with every revolution of the wheel. Any hay containing it is practically valueless

➤ HE MEASURES X RAYS

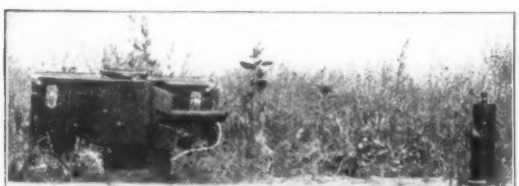
Dr. F. K. Richtmyer, Professor of Physics at Cornell University, demonstrating the measuring of an X-ray beam at a recent meeting of the New York Electrical Society. Dr. Richtmyer is an authority on physiological optics and has done much investigation of the photo-electric effect. During his scientific career, he has been a physicist at the Bureau of Standards, president of The Optical Society of America, and has held other high positions in the field of research

Prospecting with Artificial Earthquakes

How Hidden Mineral-Bearing Formations are Sought by the Seismic Method

By KARL L. KITHIL

GEOPHYSICS in relation to scientific prospecting is now recognized as an adjunct to geology proper. We shall deal here only with one method of geophysical prospecting, often referred to as the "seismic" method. It is the study of vibrations which travel through the earth. These vibrations are produced by artificial disturbances at or near the surface and are measured and determined at points distant from the disturbance.



PORTABLE FIELD INSTRUMENT SET-UP

Figure 1: As the recording is done by optical methods, an opaque tent must be placed over the instruments

Various delicate instruments have been assembled for this purpose. They vary in construction and to some extent in principle. They may be called seismographs, but are really vibrometers, oscillographs, or seismo-vibrographs.

The chief object is to determine, from records obtained by these recording instruments, the idiosyncrasies of earth wave travel between any given point of artificial disturbance to other distant points where such instruments are installed. From a knowledge of these factors some of the structural conditions of the deposits between these points can be deduced. The problem is anything but a simple one and may under certain conditions become too complex to permit any interpretation.

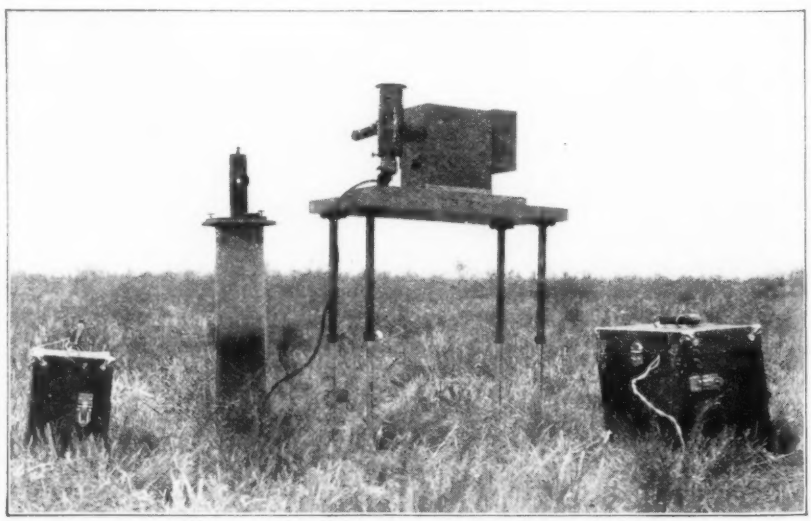
TO expect to obtain results which can disclose the true or even approximate condition of the composition of any portion of the earth requires a most complete knowledge of geology. Geology deals with the structural conditions of our earth. We know that beneath the topsoil of the earth exist many different kinds of rocks of different ages and of different composition, and that they were deposited in the ground under greatly varying circumstances. By natural action these earth masses and existing structures have often been dislocated, rearranged, and broken up, sometimes forming very complex structures. As time went on they have undergone further changes caused by redeposition, eruptions, and other agencies.

In spite of this apparent chaos, however, it is possible for the trained geologist to study these conditions and to piece together the knowledge which is revealed to him by exposures here and fragments there, or by other visible disturbances elsewhere. This latter study, however, is practically limited to what can be observed from the surface or in artificial openings. Geologizing for formations, therefore, whether it be for those likely to be mineralized or for oil and gas, is difficult and often impossible where surface indications are either entirely missing and where the evidences are covered with loose materials.

The "seismic" methods, which are classified with other geophysical methods of prospecting, can not, of course, discover minerals or ore bodies themselves, except perhaps in a very few special cases. It is, however, possible to discover and determine by such means the existence and possible location of formations beneath the surface of the earth which may contain mineral deposits. We can also detect the occurrence of fault zones, folded areas, dike intrusions, thickness of cap rock formations overlying mineral substances, and thickness of alluvial beds overlying bed rock. Their probable location and extent as well as depth below the surface of the ground can in some cases be determined and approximated.

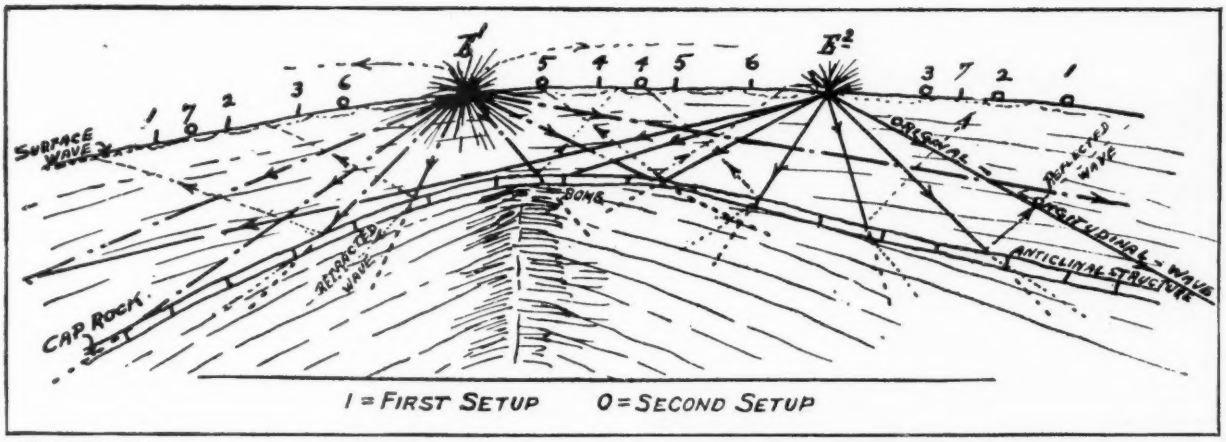
WHILE such information is highly valuable to those interested in the development of the mining and oil industries, it must be understood that so far it has not been possible to tell from such determinations—even if the structural conditions have been accurately defined—whether, for example, the ground so tested contains either gold in alluvium, or minerals within a certain formation, or oil and gas under typical oil and gas structures. The ground which has disclosed these formations or structural conditions through seismic tests must be opened up by digging or drilling, or may be checked up by other geophysical methods.

We now proceed a step further and delve into the theory of the phenomena of wave transmission and wave propagation through solid earth materials. An artificially created earth disturbance results in the propagation of a wave through the surrounding earth materials. The waves, during their propagation through the earth, are



ANOTHER VIEW OF THE SAME INSTRUMENTS

Figure 2: Here the receiving instrument rests on a metal pedestal and sends its beam of light to the photographic recording apparatus placed on a collapsible table. Tent not shown



All sketches by the author

A TYPICAL EXAMPLE OF A SIMPLE PROBLEM IN SEISMIC PROSPECTING

Figure 3: Explosions brought about at different times at E^1 and E^2 send their respective waves or vibrations in all directions. Some are refracted through the cap rock of the dome, others are reflected and caught by instruments placed at various locations

subject to all kinds of hindrances, causing reflection, refraction, diffusion and other changes, when passing from a medium of one kind to another. These influences cause changes in the speed and character of the original waves and their rays as they are propagated through the various kinds of materials and before they arrive again at the surface of the earth at some other point.

Now let us go into the field at an actual place to be tested and where preliminary geological observations have given indications of the possible existence of suitable formations.

We see only the surface material and can only surmise what the ground below may hold in store for us. We also do not know what the conditions are of any of the suspected underlying formations, so far as placement is concerned—whether any changes have been caused in their original position by intrusions or otherwise, or whether these formations have been tilted, folded, or broken up, and whether older or more recent materials are interbedded.

At selected points we place our instruments at predetermined distances from each other. Then we place a charge of dynamite at about the center of the area, or some other suitable point away from the instruments, and get everything in readiness. We next send out a radio wave which through suitable short wave receiving sets starts all instruments simultaneously in operation. After a short time interval we fire the shot of dynamite.

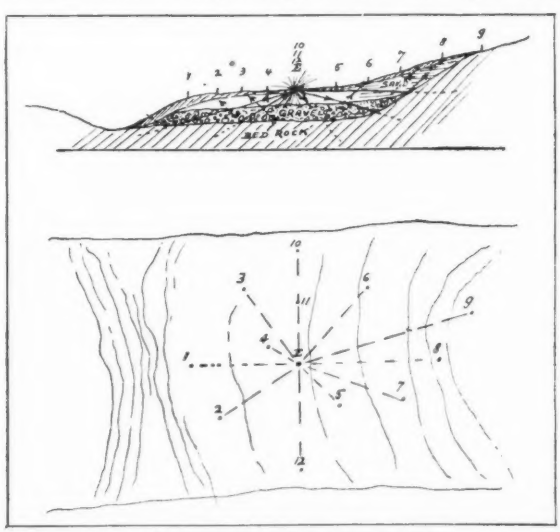
THE entire operation takes only a short period of time and the record is completed. The apparatus should be provided with an automatic cutout, so that the recording device of the individual instruments will come to a standstill after several seconds of time. After that the photographic film or sensitized paper on which the record is automatically made is taken from the instrument and developed, marked and taken back to the office; or else interpretations can be made in the field, especially when the knowledge of the results obtained is of immediate importance and where new readings with a different set-up are required.

What has happened is as follows: Earth wave travel resulting from the explosion was recorded. The interpretation of the records requires a knowledge of geology, physics, and mathematics. The record shows great complexities in the registration of the lines of configuration, time factors for the arrival of the individual rays, the magnitude of the vibratory movements, their period and, in short, the character of the arriving waves. In fairly homogeneous ground these lines are represented by more or less harmonic movements, whereas in broken up ground or mixed ground these movements become very irregular.

EASILY TRANSPORTED

Figure 4: To facilitate rapid work in the field the apparatus must be light

Earth wave travel can be best described as a propagation or forward pushing of vibratory, tremor-like movements within and through earth materials, radiating or expanding in all directions, seeking always, however, the quickest route to return to the surface of the earth. The velocity of wave travel through solids depends upon the density (specific gravity) and elasticity of the various rock or earth materials through which these waves have to pass. As all the different strata constituting the crust are composed of all kinds of materials of different geological ages their composition and consequent physical qualities likewise differ greatly from each other. The various strata differ greatly in moisture content, or the lack of it, which also in-

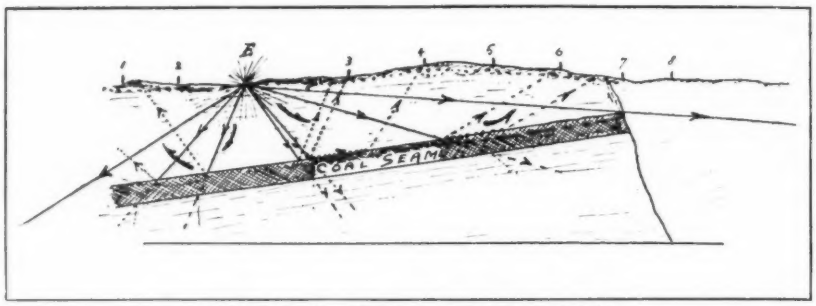


ANOTHER BURIED PROBLEM

Figure 5: Here the depth and extent of gravel strata are being worked out. The gravel may contain gold

fluences the physical properties of the various rock formations and its individual constituents. These are all very important factors, so that not only density and elasticity but also factors of compressibility or incompressibility, torsional properties, and so on have to be taken into consideration—all of which have some influence on the wave propagation and on the relative movement of the vibratory phenomena.

Let us take under consideration an area of ground to be seismologically tested, which from surface conditions appears to be a relatively flat area of land. We suspect that different conditions lie hidden under the soil—conditions which do not conform to the contour of the surface. Take, for example, Figure 3, the surface being covered with soil. Below the deposit of soil is a stratum of material of recent geologic formation, perhaps sandstone and shale. Underlying these is a layer of material of older formation, which

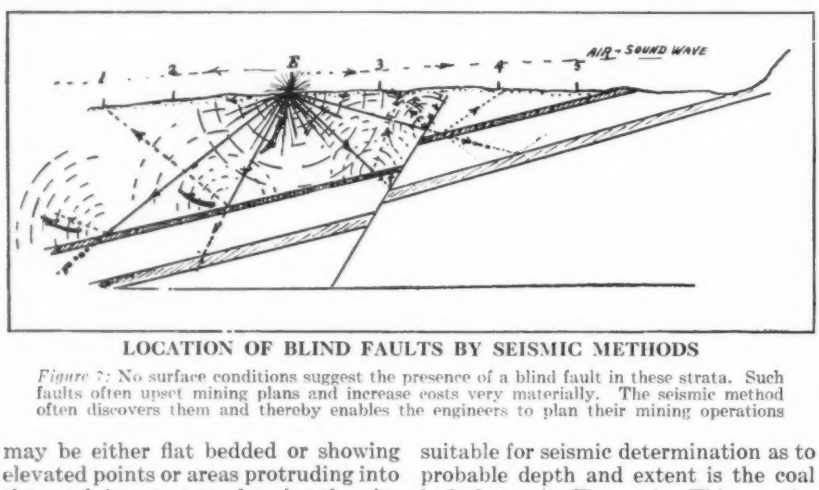


OUTLINING A HIDDEN SEAM OF COAL

Figure 6: No tangible evidence of coal is in sight, although deduction from geologic evidence indicates its probable existence in the locality. The seismic method then locates the presence, depth, dip, and strike of a suspicious stratum which ends at a fault line

some placer ground, gold and black sands or other minerals in concentrated form associated with the gravel, such a content can not be discovered by such a method, but other geophysical methods, such as magnetometers, may then be applied.

Another form of deposit which is



LOCATION OF BLIND FAULTS BY SEISMIC METHODS

Figure 7: No surface conditions suggest the presence of a blind fault in these strata. Such faults often upset mining plans and increase costs very materially. The seismic method often discovers them and thereby enables the engineers to plan their mining operations

may be either flat bedded or showing elevated points or areas protruding into the overlying stratum, forming thereby dome-like structures, anticlines or similar structures; or else showing depressions into the deeper lying rock formations such as synclines. In such cases we can reasonably expect to find by means of the seismo-vibrographic method of measurement the probable depth to the contact of this material. By numerous set-ups of the instruments and repetition of the operation under varying conditions we may obtain enough data from these records to plot out the approximate contour lines and probable depth of this formation.

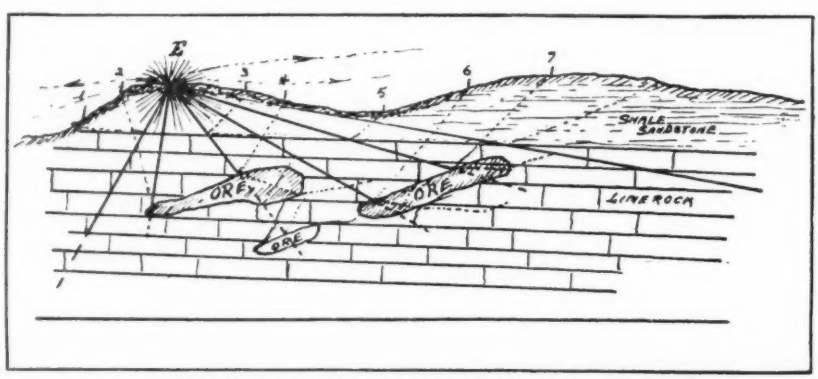
Another example is to determine the thickness and extent of alluvial gravel beds. Figure 5 shows such an alluvial condition. It is covered up with soil to a shallow depth. Below that is 30 feet of alluvial gravel, lying on the bed rock. At points east and west in the lower part of the drawing are indicated the contour lines which show the extent of these alluvial gravels. The depth of such a bed can be determined seismo-vibrographically.

If such beds contain, as is the case in suitable for seismic determination as to probable depth and extent is the coal bed shown in Figure 6. This, as the sketch indicates, is covered up with soil and another rock formation. From other geological observation and deductions previously made, the presence of such occurrence may be expected. The seismic method may reveal the desired data, as to the presence of the formation as well as its extent and depth below the surface. This can then be checked up by means of the electrical conductive methods of geophysical prospecting.

Fault zones covered with surface materials (blind faults) and rock intrusions of varying physical properties may be discovered by seismic methods; for example, see Figure 7.

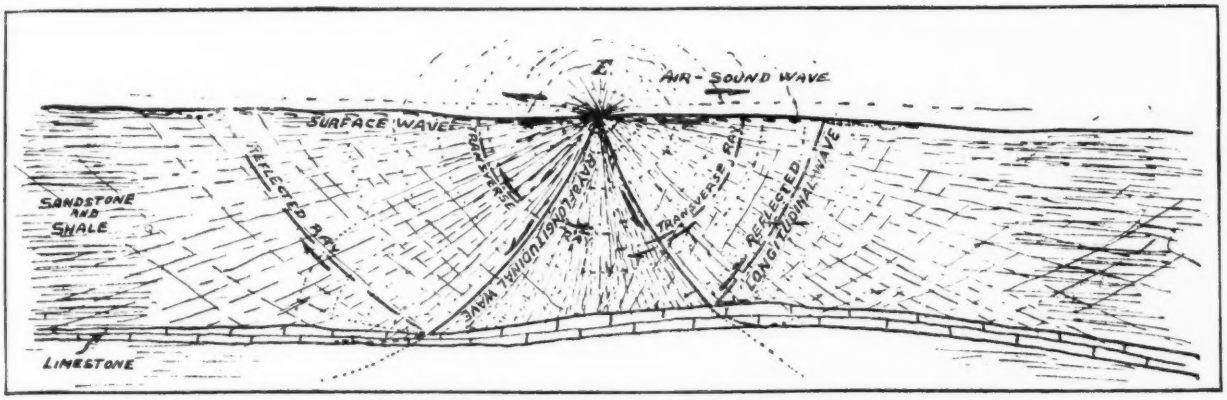
A LARGE body of especially dense material, such as a mineral ore body, imbedded in less dense rock material (Figure 8) but of a more or less homogeneous nature, can also be expected to lend itself to detection by such a method. However, in such a case it cannot be ascertained directly whether the ore body contains iron, lead, zinc, copper, or other minerals. However, the existence of an ore body of greater density and elasticity within a rock formation of considerably lesser density and elasticity should form an excellent target for reflected seismic waves, and could be followed up, as in the case of sulfide ore bodies, by some of the electrical geophysical methods.

Oil pools and gas accumulations are found under cover within anticlines (high points of an arched structure) often deeply buried beneath the surface; or such accumulations are found along the flanks or on top of salt domes. If the conditions are such that this cover overlying the oil or gas pools is of a material having a different density and elasticity than the other masses or



PERCUSSING THE EARTH WITH DYNAMITE

Figure 8: By thumping or percussing the body the physician locates the various organs and any existing growths. Exactly the same principle is employed to find some ore bodies



A GENERALIZED PROBLEM IN SEISMIC WAVE TRAVEL

Figure 9: The source of the disturbance is a charge of dynamite set off at *E*. Sound waves reach apparatus set up at various points, through the air. Radio waves travel faster, however, and are preferable for recording the exact instant of explosion

strata, then the presence of such a condition can be revealed by the seismic method. However, the method cannot reveal whether oil or gas exists in the structure, even if the formation favorable for such an accumulation has been determined.

BRIEFLY stated, we may detect by the seismic method, formations which may turn out to be mineralized, their relative position in the ground, and some of the irregularities in their outline. From interpretable records so obtained, it is possible to learn something of value, which may decide whether further prospecting by other known means of geophysics should be undertaken. This will, to some extent, prevent the expenditure of large amounts of money which are being wasted for wild-catting and fruitless prospecting in unknown ground. This method, in conjunction with other geophysical methods, may help to discover some of the mineral resources the existence of which would never become known to us without such means.

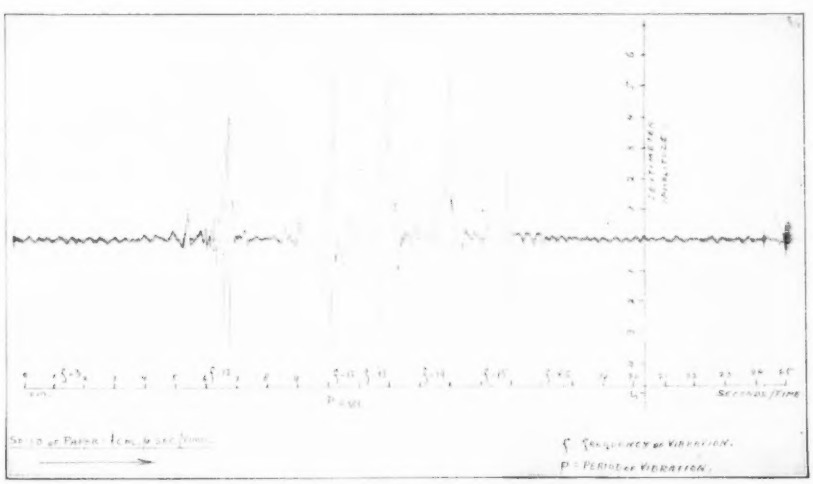
With the development in the field of radio it is possible to employ on each of the recording instruments, a system of radio relays connected with individual receiving sets. These will set all apparatus in operation simultaneously and thus, correct time factors can be obtained. The determination of the differences in time between the recording of the moment of the disturbance and the arrival of all of the successively arriving impressions of wave impulses is of course of great importance.

The records obtained by such means should be taken photographically and preferably by optical means, which permits large magnification of the very minute configurations of the vibratory movements. The records must show the required time intervals in at least one tenth of a second of time, and the speed of the recording paper or film should be high enough to record even relatively high frequencies and take large amplitudes of the recording beam.

The probable effect of a blast of dynamite at the surface of the earth is illustrated in Figure 9. Earth waves are slightly curved rays which are transmitted and propagated in all directions through earth material. A sound and air wave are also created as a result of the explosion, and this is transmitted through the air in all directions. The effect of these latter waves which arrive simultaneously is also recorded on the field instruments. They can easily be recognized, however, by their slower speed and by their different characteristics recorded on the photo-diagram. All these various waves such as longitudinal, transverse, surface, and air-sound waves have different speeds in the order mentioned, the air-sound wave being the slowest.

THE description presented above shows only the simplest form of application. Nothing can be said as yet regarding the possible outcome of such an application in mountainous regions where the greatest heterogeneity of earth materials is known to exist. The greatest accuracy is necessary, whatever method of geophysics is employed or whatever instruments are used for the purpose. The closest cooperation between the geologist, the physicist, and the mathematician is required. So far it has proved possible to determine seismographically only the simplest type of geological structures or formations. As years are added to the experience of the workers, more skill may logically be anticipated.

Finally, a word of caution: The seismic method must not be confused with the so-called "doodle bugs," which depend upon imaginary personal influences or idiosyncrasies of the individual operator. The newer geophysical methods are entirely instrumental and are free from any alleged personal influence or the imagination of the operator. The entire procedure is highly fascinating and interesting and may eventually become of great importance.



AN ACTUAL PHOTOGRAPHIC RECORD

Figure 10: One thousand fold magnification of the recorded vibrations is obtained by reflecting them from a tiny mirror, in a manner similar to that employed in the D'Arsonval galvanometer. This particular record shows the arrival of seismic waves reflected from five underground surfaces. These records are timed (note horizontal scale) while their amplitude is measured on the vertical scale. From this it is possible to calculate the depth and other positional characteristics of the respective reflecting surfaces, and plot the stratigraphical conditions, if they are not too complicated, lying hidden below the surface

The Month In Medical Science

A Review and Commentary on Progress in the Medical and Surgical Fields

By MORRIS FISHBEIN, M. D.
Editor of the Journal of the American Medical Association *and of* Hygeia

Ultra-violet Rays

AMONG recent investigations of the use of ultra-violet rays is a series of studies made in the Children's Hospital of Western Reserve University School of Medicine. An attempt was made to find the approximate minimal dose of ultra-violet rays as produced by the quartz lamp, which, with exposures given once weekly, would cure rickets. White and colored children were given exposures to the quartz lamp and the extent of the rays was measured by the response of the skin.

Regular pictures were taken with the X-ray machine to find out how much the bones were reacting to the dosage. All of these infants were receiving diets of orange juice, milk, skim milk, and lactic acid, with enough sugar to meet the requirement for energy according to age. It was found that exposure of the infant by placing it, while naked, on the stomach or back for one period each week would cure rickets.

The quartz lamp was placed at a distance of 32 inches for ten minutes, that being a sufficient dosage. In white children with tender skins there is decided redness following such exposure, but not inflammation to the point of peeling of the skin. In case the reaction of the skin is too severe, the dose may be reduced to one half the amount mentioned.

Punch Drunk

AFTER a prize-fighter has had a terrific pounding in the prize ring he may suddenly find himself dizzy and unable to move his legs—or "out on his feet." Dr. Harrison S. Martland accepts the name "punch drunk" for this condition which the fighters themselves call "cuckoo," "goofy," "cutting paper dolls," or "slug nutty." The condition usually occurs to fighters of the slugging type who are poor boxers and who get a lot of head punishment while trying to put over a knockout blow.

One or two hours after the fight the boxer recovers from a hard punch to the head or jaw. If he has been "punch drunk," he may notice later a flopping of one foot or leg in walking, and sometimes mental confusion lasting several days.

Doctor Martland has shown that the condition called "punch drunk" results from a brain injury in the form of multiple small hemorrhages. In the late stages, the condition resembles the "shaking palsy," or Parkinson's disease. Microscopic studies of the brains of persons who have developed this condition show the little spots of bleeding deep in the brain. The records of 23 fighters who have been "punch drunk" show that the physical changes are permanent and may lead to mental defects requiring final incarceration in some asylum.

Pranks With Compressed Air

AT least several times each year deaths are reported of workers in industry who have been subjected to practical jokes or "horse-play" by other workers. In many plants today compressed air is used regularly for many purposes. This is particularly the case in steel welding and in building construction. In some plants air at a pressure of one hundred pounds to the square inch is used in automatic riveting. Recently in an English shipyard a boy aged 14 was killed by a blast of compressed air which entered his bowels when some workers put the hose next to his body as a joke. His intestines were blown to pieces and portions of the boy's clothing were found within the body. In the English case the men who had pointed the hose at the boy were held for manslaughter and committed to trial. The human body is not built to withstand a pressure of one hundred pounds to the square inch.

Changes in Posture

THE health of the growing child is determined by its heredity, its nutrition, infections, and its posture. By our inheritance we have a certain body form which is like that of previous members of our families. Some persons have long, thin muscles; others short, fat muscles. Some people are big boned; others small boned. In the human being, as emphasized by Drs. Sweet, Watson, and Stafford, the middle zone seems to be the place for greatest happiness. People who are too tall or too short find that the world is not accommodated to their convenience. If certain groups of muscles are too strong, the body is tilted into abnormal positions. If nutrition is bad, tissues fail to develop properly; infections may paralyze nerves to such an extent that muscles are unable to act or become weakened and again the body assumes strange positions.

In their consideration of changes of posture during life, the California investigators point out that every child is bow-legged to begin with, becomes progressively knock-kneed, this condition reaching its height at three years of age and receding rapidly in the normal child during the following two years. Formerly physicians were much concerned about this deformity, but nowadays they merely determine that knock-knees is not an inherited family characteristic, and see to it that the child does not wear shoes that are too short or too rigid and which will tend to prolong the condition unduly. Shoes that are too short force the feet into a position which encourages knock-knees. Rigid soles on the shoes of young children prevent development of the foot muscles.

A bed that sags in the center emphasizes the forward droop of the shoulders, especially if a pillow is used. People who sleep on one side in a bed that sags in the center tend to develop a spine that swings sidewise.

As exercises for a child of three years which will aid him in developing proper posture, the authors recommend the following: While lying on the back, the legs, widely separated, should be raised and lowered; while lying on the stomach, the head should be lifted backward and lowered. During the latter exercise the hands may be held over the middle of the back to emphasize the lifting of the shoulder girdle.

Yellow Fever Transmission

WITHIN a year three well known investigators sacrificed their lives to the investigation of yellow fever on the Gold Coast of Africa. The list includes Adrian Stokes, William A. Young and the famous Hideyo Noguchi. Apparently the yellow fever in that territory is more uncontrollable than almost anywhere else in the world. Few people realize the difference between the present era when only a few plague spots of this disease remain to trouble civilization and the time one hundred years ago when yellow fever was a constant menace.

The work of Dr. H. R. Carter and leaders of the Reed commission in Havana and of Surgeon General Gorgas served to eliminate the disease

from most civilized sections. However, the campaign goes on. Dr. Johannes H. Bauer's recent report from Lagos, Nigeria, West Africa, indicates that certain forms of African mosquitoes related to the *stegomyia* may transmit yellow fever. He recognizes that H. R. Carter many years ago expressed the opinion that following the analogy of malaria and some other insect-borne infections, these other varieties of mosquitoes would be found associated with the African transmission of yellow fever.

The work of the investigators in Africa develops the important fact that the monkey, known as *Macacus rhesus*, can be used for experiments with yellow fever, thus making it no longer necessary to carry on the dangerous human experiments by which the fundamental facts of mosquito transmission were first established.

Doctor Bauer made studies of many varieties of African mosquitoes, and was able to list three definite varieties which transmit the disease.

"Rider's Legs"

BASEBALL players and football players suffer frequently with "charley-horse," which is essentially a stiffening of the limb due to the rupture of muscle fiber which causes a hemorrhage into the tissues and subsequent pain on movement. Apparently an injury of similar character is "rider's legs." This is a strain of the adductor muscles of the thigh brought about by a sudden forceful gripping of the saddle by the rider in an effort to avoid being thrown. The person affected, at once feels severe pain which may be so severe as to prevent further riding. Recovery may be complete in from two to three weeks, but in some cases the healing may require months. It is quite possible that the mechanism of the injury is essentially the same as that which occurs in "charley-horse," which is due to a sudden movement when the person is off balance.

Dr. D. F. Winn of the Army Medical Corps recommends strapping with adhesive tape to hold the injured tissues in a fixed position and the application of heat regularly to insure a good blood supply and aid recovery. The use of an elastic stocking as a support to the adhesive is sometimes helpful.

Road Tar Poisoning

A MAN about thirty years old was tending a tar wagon; he left the wagon temporarily and some mischievous children opened up the escape valves of the boiling tar. The man ran about a third of a mile to the tar boiler, and found a lake of tar on the road, covered by clouds of fumes. He waded through the fumes to shut off the valves, breathing deeply because he was out of breath. After coming out of the fumes he became violently ill with convulsions, and has since had repeated hemorrhages from the lungs. Acute inflammation of the kidneys developed, later a severe anemia, and finally disturbances of the nervous system.

Road tar, as has been emphasized by Dr. Carey P. McCord, is a combination of chemicals left after coal-tar distillation. When applied repeatedly to the skin it causes irritations such as tar cancer. Because of the chemicals involved in tar, almost every one of the systems of the human body may be affected. The benzene portion of the tar has a specially destructive effect on the blood and may be responsible for the hemorrhages and anemia. From coal tar, phenol, also known as carbolic acid, is derived. When taken into the body, it is extremely caustic. It will burn the tissues with which it comes into contact. After the poison enters the system convulsions follow. From coal tar also are derived various anthracene products. When these are taken into the system, there results a water-logging of the lung tissue. There are many industries in which coal tar and various derivations, beside those that have been mentioned, such as toluol, naphtha, benzene, and aniline, are concerned. Workers with such substances learn to treat them with respect because they soon become aware of their dangerous possibilities.

Decaying Teeth in Childhood

CHILDREN anywhere from six to ten years of age frequently develop a process of decay in their teeth which results in a rapid loss of many of the permanent teeth in the older children. In younger children, the first teeth are destroyed rapidly and the second teeth come in crowded, crooked, and with defects leading to their early break-down.

It is generally conceded that a break in the enamel of the tooth is an important factor in early decay. From time to time various bacteria have been alleged to be of importance in causing early decay of the teeth, but a specific germ has not as yet been isolated which is invariably associated with such processes. As pointed out by Drs. Julian D. Boyd and C. L. Drain, sometimes the teeth decay under the best of mouth hygiene.

These investigators studied tooth decay in the State University of Iowa College of Medicine, and came to the definite conclusion that dental caries depends on dietary inadequacy, such as is sometimes associated with the food intake of the average child. They were led to this view by the fact that diabetic children who were put on good diets began to recover promptly from tooth troubles.

They point out that the average child is generally allowed to use his appetite as an index of his food needs, and that his menus are determined by the choice of foods offered to him. An analysis of the average diet showed it is deficient in vitamins and mineral salts, sometimes to a marked degree. The giving of a diet that is rich in mineral salts and in vitamins resulted in the stopping of dental caries in 28 diabetic children, 82 percent of whom had shown definitely progressive decay of the teeth prior to the giving of a correct diet.

The Colors of Foods

NOT the smallest part by any means of the attractiveness of any diet is the natural color of the food substances that may be concerned. The red of the apple, the blue of the plum, the yellow of the banana, the orange color of the lemon, orange, and grapefruit, the green of the spinach, watercress, lettuce, peas, and string beans, the red of the tomato, and the yellow of carrots are significant in our appreciation of these fruits and vegetables. Butter of a pale and ghastly hue is so unattractive that artificial coloring is permitted in butter substitutes. Indeed, coloring is such a significant part of the diet that it would be practically impossible to devise a meal of pure white constituents.

The investigators in physiologic chemistry have been studying the coloring matter of foods with a view to finding out if these have any other usefulness in the body than the esthetic one. In addition to the green chlorophyll of plants, the leaves contain two pigments, xanthophyll and carotin, which form yellow solutions. These pigments are found also in corn, carrots, and sweet potatoes. They are practically always found together but in varying percentages. Their occurrence in the yellow of the egg or in milk, is dependent on the food that the chicken and the cow may eat.

Drs. F. P. Underhill and L. B. Mendel of the department of physiologic chemistry in the Yale University recently conducted experiments in which dogs were fed a diet from which carotin was absent. These dogs developed symptoms of malnutrition which disappeared when the animals were fed as little as five milligrams daily of crystallized carotin. Here is a problem of great interest to the scientist on which as yet but little research has been done. So varied and complicated are the constituents of our diet and so new is the science of dietetics that only a small beginning has as yet been made in securing the vast amount of information that must be available through research into dietetic problems.

The Search for the First American

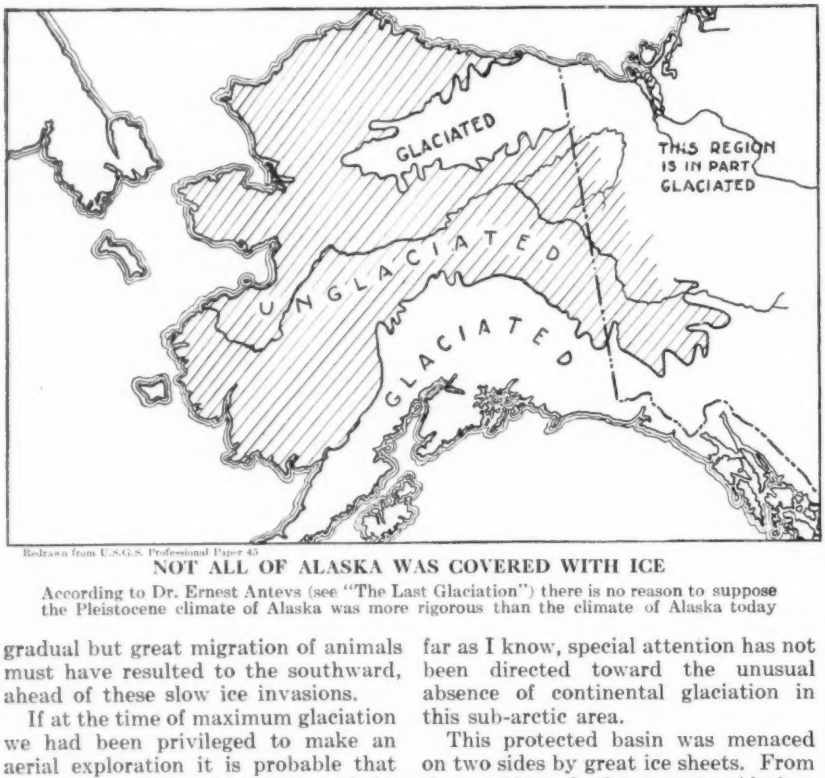
Most Anthropologists Accept the Theory that Man Reached the New World by Way of Alaska. New and Immense Excavations for Gold, if Given Attention, Might Also Reveal Evidences of This Early Emigration

By ERNEST N. PATTY
Dean, Alaska Agricultural College and School of Mines

IT is a matter of common geologic knowledge that during the late Pleistocene Epoch great ice sheets formed in Canada and then moved southward to cover the northern tier of states. Lobes from these continental glaciers extended as far south as Kentucky and Missouri. Obviously a gradual but great migration of animals must have resulted to the southward, ahead of these slow ice invasions.

If at the time of maximum glaciation we had been privileged to make an aerial exploration it is probable that we would have found 90 percent of the northern half of our continent covered by these vast ice caps. Some set of paradoxical geologic events, however, caused the Yukon Basin of interior Alaska to escape these widespread invasions. At the time when the New England States were being ground beneath the heel of the ice king, the interior of Alaska formed a verdant oasis nearly surrounded by a sea of ice.

When the writer first visited Alaska he expected to find the interior section shaped by glaciers into a glaciated type of topography comparable to that of eastern Canada. Field studies in the Fairbanks area and in other sections of the Yukon drainage basin revealed, on the contrary, a positive absence of glacial carving and of glacial debris. An examination of the excellent bulletins of the United States Geological Survey indicated that the Government geologists had recognized this phenomenon years ago. But as far as I know, special attention has not been directed toward the unusual absence of continental glaciation in this sub-arctic area.

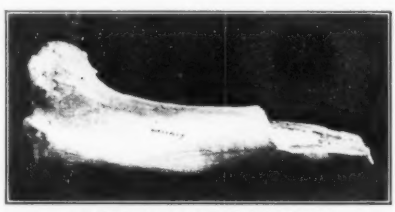


Redrawn from U.S.G.S. Professional Paper 45

NOT ALL OF ALASKA WAS COVERED WITH ICE

According to Dr. Ernest Antevs (see "The Last Glaciation") there is no reason to suppose the Pleistocene climate of Alaska was more rigorous than the climate of Alaska today

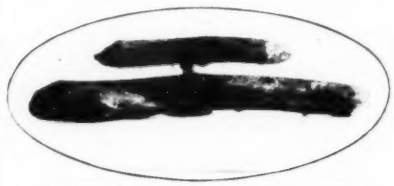
This protected basin was menaced on two sides by great ice sheets. From the southward the serrate Alaskan Range forced gigantic valley and piedmont glaciers down into the lowlands. From the north the precipitous Brooks Range and the less rugged Yukon-Tanana Highlands attempted similar invasion. Apparently there were warm summer winds traversing the Yukon Basin, which first checked and then vanquished these ice invasions. The low, open country where the Yukon and Kuskokwim deltas merge with Bering Sea, would offer favorable admission for these warmer summer winds from the Pacific. Possibly a better explanation exists, but the above appears most obvious.



PERFECTLY PRESERVED

Note central marrow. Even an ancient man, if soon frozen, would have been preserved in the frozen Alaskan soil

If these conditions prevailed we would expect that the Pleistocene mammals of the northland would seek refuge in great numbers in this protected basin. Such a deduction is confirmed by the fact that placer gold mining operations beneath the stream valleys of the Yukon Basin are uncovering profuse skeletal remains of these mammals. Undoubtedly, during the glacial period, the valleys of interior Alaska teemed with animal life.



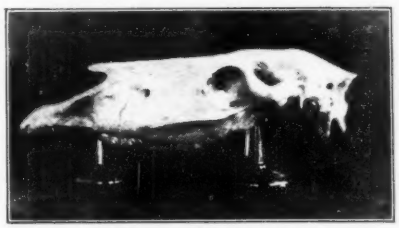
ANCIENT BEAVER CUTTINGS

These pieces of wood in perfect condition were found 20 feet beneath a valley floor

Well preserved skeletal remains of the hairy mammoth, northern bison, Pleistocene horse, musk ox, elk, caribou, bear, and beaver are found when the placer miners delve beneath the valley floors in search of gold-bearing stream gravels. These finds are not restricted to certain areas but they constitute usual occurrences in practically every valley explored in the Yukon-Tanana drainage basin.

The bed rock under these streams is floored with a deposit of gravel varying from 6 to 40 feet in thickness, and this gravel in certain areas contains sufficient placer gold to make mining profitable. It is a fortunate coincidence that these animals were caused to travel over gold-bearing gravels. Otherwise we would have but scant knowledge of their presence.

The Yukon and Kuskokwim rivers constitute the ultimate drainage conduit of all water falling in interior Alaska. During the glacial period the Yukon apparently was dammed, possibly by a glacier advancing across a constricted place in its valley. This damming caused the water to back up into the tributary valleys and convert these valleys into temporary lakes. A muddy ooze collected in these lakes. Later, the barrier dam gave way, the water receded from the tributary valleys, the ooze-like sediment that remained was permanently frozen and a mat of vegetation developed, effectively insulating the frozen ooze from the summer sun.



PLEISTOCENE HORSE

This skull was found with mammoth remains 40 feet below the valley floor

This frozen mud-ooze the miners call "muck." When the protective mantle of moss and nigger-head grass is stripped from it, the muck thaws in the sun and changes into a semi-fluid ooze which can be easily swept away in suspension by running water. It is this frozen blanket of muck, 20 to 200 feet thick, covering the gravels, which hampers the placer miners—they must penetrate it and often sluice it away before they can work the auriferous gravels beneath.

When the miners penetrate the muck with prospect shafts they use steam points for thawing and occasionally as the muck is thawed it emits an offensive odor of decaying flesh. Bits of hide with the hair intact are sometimes encountered in the muck. The skeletons are in some instances complete, with the marrow still present in the larger bones. In other instances only fragmentary bones such as the more resistant femurs and skulls predominate. No doubt a careful search would reveal the bones of smaller mammals, but it is the larger bones that attract the attention of the miners. Until very recently these miners have been the only collectors in the field.

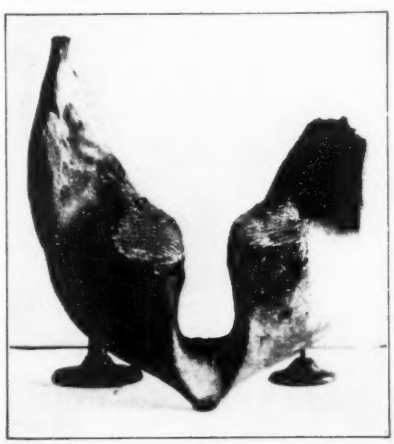
Most of the skeletal remains are found near the base of the muck, while others are immediately at the junction of the gravels with it. This would lead to the inference that these animals were traveling on the gravel bars when they met death and that subsequently they were covered by the muck.

In places, a veritable bone yard of different animal remains is found in a small patch. However, the evidence indicates that these animals did not meet death by some isolated catastrophe. Rather it suggests that with the flooding of the valley floors they retreated to the adjacent hills, and an occasional animal returning to the water's edge would become bogged-down in the muddy ooze. Possibly this explains the abundance of bones of the massive animals such as the hairy mammoth and the northern bison and the paucity of remains of the caribou, bear, and horse.

ALL of these animals would survive the present climate of interior Alaska. With the exception of the hairy mammoth, northern bison and Pleistocene horse, they did survive the glacial epoch. The musk ox roams today on the barrens northwest of Hudson Bay; the caribou and the bear are of widespread occurrence in Alaska; and the beaver with his engineering bent, continues to build his dams along the same design that his ancestors formulated some 50,000 or more years ago.

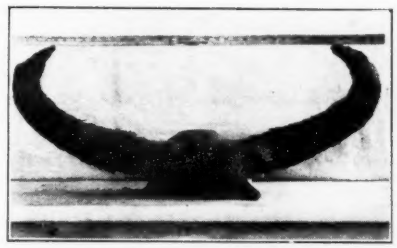
We know that the mastodon was plentiful in the United States at this time, but apparently he did not flourish in Alaska. In the museum of the Alaska College there is one well-preserved set of mastodon teeth which a prospector discovered on a gravel bar in the Yukon River, four years ago. This is the only evidence that the writer has seen which indicates that at least an occasional mastodon took refuge from the descending glaciers in the Yukon Basin.

All of this opens a more significant and important possibility. Many paleontologists have suspected that man inhabited the North American continent during the glacial epoch, but so far no positive evidence has been unearthed to substantiate this theory.



TWO KINDS OF TEETH

At left, jaw and teeth of the hairy mammoth. Note corrugated surfaces. At right, tooth of a mastodon, very different from those of a mammoth. Mastodon means "nipple tooth." Note "nipples"



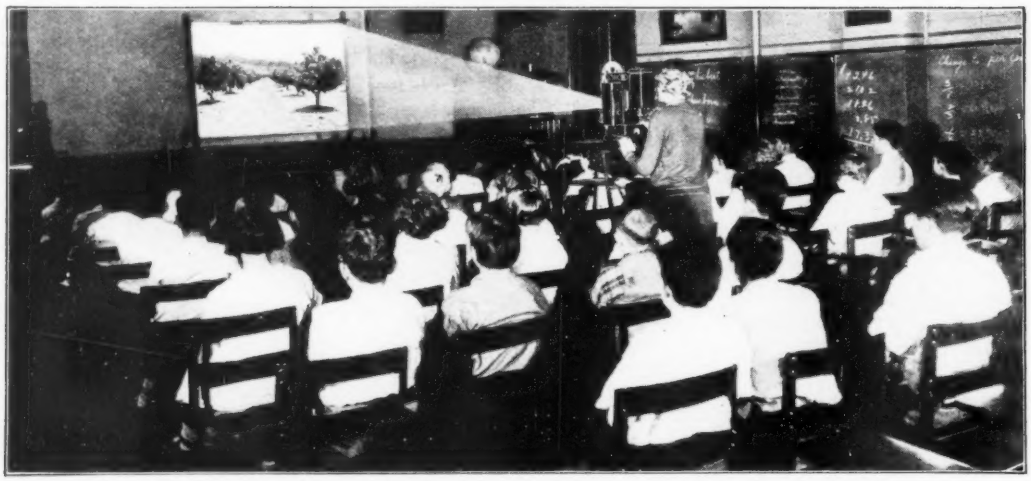
NORTHERN BISON

The horns measure 29 inches from tip to tip. This animal is now extinct

The commonest and most logical inference is that primitive man migrated from Asia, probably crossing Bering Straits to Alaska and then pushing slowly southward.

ON a clear day the coast line of Siberia is visible from Cape Prince of Wales, and only an expanse of 40 miles of water separates the two continents at this point. The Eskimos today, in their skin boats (*umiak*) regard such a journey as routine travel in ordinary weather. If primitive people traveling along the shores of Siberia saw the hills of Alaska looming up across the water, it is only natural that they would eventually cross over and investigate this new country. To them, as Hrdlicka pointed out, it would not be the migration to a new continent—simply to an adjacent body of new land which might offer better prospects for hunting. Once in Alaska their southward migration would require centuries of time to become impressive, and their line of travel would be either along the shores of Bering Sea or up the Yukon River. If they were in Alaska during the glacial period these would have been the only two routes available.

With these thoughts in mind it is highly desirable that more scientific attention should be payed to the frozen gravels and muck of the valleys of interior Alaska, for it is an easy matter without such attention to pass by positive proof of man's existence here during the glacial epoch, should they occur here.



EDUCATION IS ACCELERATED BY INSTRUCTION WITH THE AID OF CLASSROOM FILMS

Education Adopts the Motion Picture

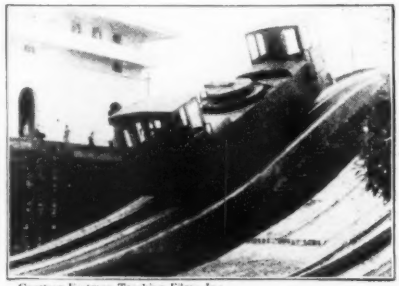
Films Prepared to Supplement the School Curriculum Prove Their Worth in Education's Greatest Experiment

By ELIZABETH RICHEY DESSEZ

FOR many years the educational value of the motion picture has been recognized. However, many problems have confronted the teacher who has wanted to adapt films to subjects taught in school curricula, and the producer who has considered the production of pictures for classroom use. From the viewpoint of the teacher, the outstanding problems have been the high cost of projection equipment and films, and the scarcity of pictures produced or edited for instructional purposes. For the prospective producer of educational pictures, the main stumbling block has been the limited and unorganized demand for such films, which cannot be produced and distributed without a large investment. Fortunately this situation has undergone a change, slowly at first but increasing rapidly in the past few years.

WITH the co-operation of outstanding educators, several companies are now selling or renting educational and classroom films which meet the needs of the educational world—films of real educational value, at moderate prices. Of the companies now engaged in making educational pictures, there are four which are outstanding: the Eastman Kodak Company, the De Vry Corporation, Pathé Exchange, Inc., and the University Film Foundation.

Pathé, the oldest motion picture company in the United States, has been engaged in this educational work the longest. This firm's large library of negatives includes much valuable scientific material—records of expeditions to many countries, the pictures of the important historical events of the past two decades, and so on, which had been filmed by news-reel cameramen all over the world. This company secured the assistance of experts at the United States Department of Agriculture in the preparation of pictures on commercial geography; and scientists at the American Museum of Natural History co-operated in the editing of a series on nature study. During the past two years, the Division of Anthropology and the Department of Geology and Geography at Harvard University have co-operated with the Educational Department of Pathé in the production of two series of pictures, one on human geography and one on physical geography. These pictures are edited by graduate students employed by the company. Dr. Ernest A. Hooton and Dr. Kirtley F. Mather, members of the faculty at Harvard, supervise the work and approve each finished reel.



Courtesy Eastman Teaching Films, Inc.

ELECTRIC "MULE"

This scene was filmed at the Panama Canal as an aid in commercial geography

Shortly after the Harvard-Pathé contract, the University Film Foundation was incorporated, to engage solely in the production and distribution of teaching films on a non-commercial basis. This group also made an agreement with Harvard, and certain professors and graduate students are preparing educational films. The Foundation has an ambitious program of production and is under the direction of John A. Haeseler, who has been working with educational films for some time. Its work will be watched with considerable interest.

THE Eastman Kodak Company approached the field of visual education in a scientific manner. Some of the other producers of educational pictures who had started at a time when educational pictures were in their infancy, had been forced to advance slowly by the trial and error method. Mr. George Eastman decided to learn all he could about educational pictures before his company embarked on a program of production. One of his first steps was to secure one of the country's most eminent educators, Dr. Thomas E. Finegan, to be president of the Eastman Teaching Films, Inc.

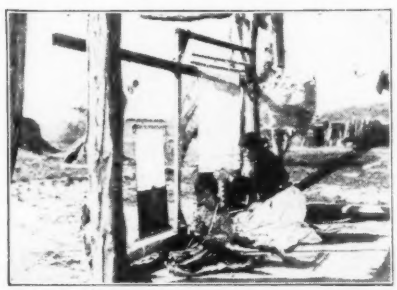
Under his supervision, and sponsored by the National Educational

Association, a most comprehensive and scientific investigation was conducted, which has been called "the greatest experiment in the history of education." The purpose of this experiment was to provide facts from which could be determined the exact educational value of specially prepared classroom films, whether the company would be justified in adopting an extensive program for producing such films, and whether the films could be produced at a cost within the purchasing power of the schools.

Dr. Finegan enlisted the services of Dr. Ben D. Wood of Columbia University and Dr. Frank N. Freeman of the University of Chicago. Both men had the confidence of the teaching profession of the country. More than 10,000 pupils in 12 representative cities participated in the experiment. It is particularly noteworthy that all of the films used in the schools during the investigation were originally produced and edited according to scenarios written by experienced educators specifically for classroom use. The tests were conducted under standards which are recognized in educational circles as modern and sound.

THE results of the investigation furnish conclusive proof of the value of motion pictures in the classroom. The 5500 pupils in the experimental groups using classroom films, gained from 15 to 33 percent more than the 5500 equally competent pupils in groups which did not have the films. The experiment provided the desired information as to the value of properly prepared motion pictures, and since that time the Eastman company has been producing additional classroom films and will eventually be able to provide such pictures for all academic needs.

It is hardly necessary to say that the educational and motion picture worlds have benefited tremendously from the experiment. It justified the faith of those who were convinced of the value of films but had never been able to prove it. The test encouraged those whose faith in educational films had begun to waver, and convinced many confirmed sceptics among the teachers and film producers that teaching with pictures could be made beneficial and profitable to both.



Courtesy Pathé Exchange, Inc.

INDIAN WEAVER

One series of educational films shows the people of all lands at work and at play

Copyright Yale University Press

RECONSTRUCTING THE REVOLUTIONARY WAR

Films depicting notable events in American history are popular in many schools. This scene, from one of the historical pictures, shows British soldiers parleying with their allies

The experiment also demonstrated conclusively what thoughtful educators had proclaimed: that motion pictures are not educational in themselves. They are a very valuable supplement, but only a supplement, to the teacher's equipment. Unless the teacher follows the simple instructions for using the films, and makes them a regular part of the classroom routine, they are merely a diversion and their use is more of a detriment than a help.

The De Vry Corporation, which of the three commercial companies is the newest in the field, is primarily a producer of cameras and projectors. Seeking a market for its product, it did not take this company long to see that educational motion pictures must be available if projectors were to be sold. The supply was limited, and consequently De Vry became a producer of educational films, enlisting the advice and approval of scientists at the American Museum of Natural History and of geographers at Teachers' College at Columbia University.

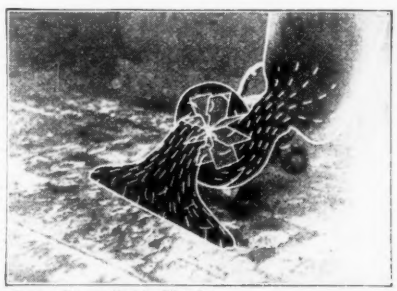
PATHÉ, Eastman, and De Vry supply teachers' aid pamphlets with all pictures for classroom use. These give outlines of what the pictures contain, the titles and scenes as they appear on the screen, and the application of the pictures to the courses of study with which they are to be used. Advice is given the teacher on how to present the film, and suggested collateral reading for the class is also furnished. The pamphlets are prepared by experienced teachers and have received the endorsement of all who have used them.

Last, not in order of importance, but because of a character different from the other projects referred to, mention must be made of the Chronicles of America Photoplays. These pictures of the outstanding episodes in the history of the United States, produced by the Yale University Press under the direction and supervision of distinguished historians at Yale and other universities, have been extensively used in both public and private schools and in colleges all over the country. The Department of Education at Yale has conducted—and is conducting—extensive experiments with the pictures in this series in order to determine the most effective means of teaching history with motion pictures.

The development of easily operated portable projectors and the use of non-inflammable film stock on the smaller and consequently cheaper size (16 millimeters) has done much to bring educational pictures into use.

Within a few more years films will be available for all branches of learning. What science will bring forth within the next few years cannot be foreseen. Already the talking picture is causing a reorganization of the whole industry. The third dimension in photography and pictures in natural colors are on the threshold, and other more remarkable developments may come.

It is now certain that motion pictures will assume an increasingly important role in education. Their worth in the classroom has been proved; their future is assured.



Courtesy Eastman Teaching Films, Inc.

HOW THINGS WORK

Animated drawings are used in a number of films adapted to general science courses

Pointers From a Pen Maker

A Fountain Pen Combined With a Mechanical Pencil Is the Latest Successful Product of a Veteran Inventor

By MILTON WRIGHT

"THERE are two main courses for any inventor to take. He can sell or lease the products of his brain to other people, getting in return a payment in cash or a royalty, or he can make and sell the invented article himself. By the first course he can make some money—in some cases a considerable amount of money, but, of necessity, the great bulk of the profits from his ideas go to someone else. Only by keeping in his own hands the business revolving about his invention can he realize fully the possibilities there are in it."

So says Julius Schnell, who probably knows more about the making of fountain pens than any man living. Schnell should know whereof he speaks, for he has tried both courses—first letting other people make the major profits from his work, and later running his own business founded on his own inventions. His newest product is the latest development in fountain pens—the combination fountain pen and pencil.

WE knew of Schnell's reputation; we had heard of how he had been making nationally known fountain pens for other manufacturers and of how at the age of 58 he had decided to throw overboard all the steady profits he was making and plunge into a new business. The story of his experience, it seemed, ought to have something of value in it for the rest of us. We sought him out.

"Just how big is the fountain pen business?" we asked, by way of getting started.

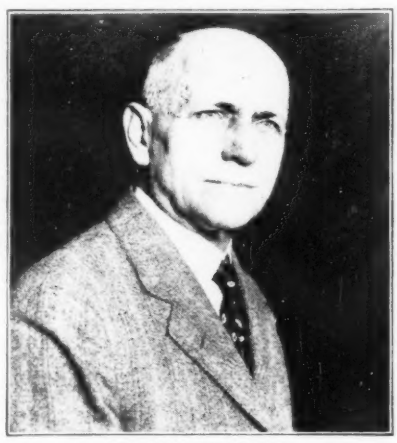
"There are twenty million pens manufactured every year in this country," he replied. We were inclined to argue the point. At that rate pens would have been made in six years for every man, woman, and child in the nation. Now every man, woman and child doesn't have a fountain pen. Furthermore, the people who do own fountain pens often keep them for years. The quantity seemed too big.

"Every year two and a half million pens are lost and three million are broken," Schnell explained. "There are more pens made every year than the year before. That steady record of increase has been going on since the first fountain pen was made in France in 1846."

"But twenty million is a lot of pens in one year, and, of course, they must be sold in rather small lots."

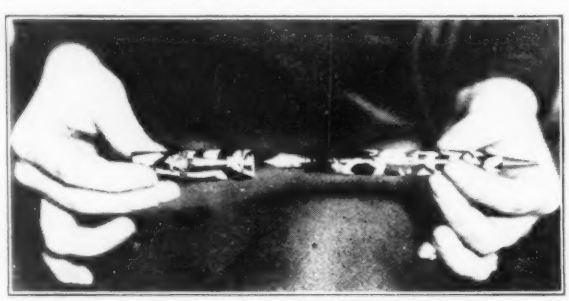
"Not so small as you might think. The American Telephone and Telegraph Company recently gave me an order for 75,000 pens."

"But what could one company do with so many pens?"



JULIUS SCHNELL

He has learned that inventors profit by becoming manufacturers of their products



A USEFUL AND BEAUTIFUL HYBRID

In addition to combining the fountain pen and the mechanical pencil, the inventor patented a new clip and filler

"Place one in the hands of each employee. The telephone company has found that it is bad business for the employees to make notes with lead pencils. They get marked up or rubbed out and many a valuable memorandum has become illegible or lost. The company's executives figure that money is saved by having all reports made in ink. They assign a fountain pen to the employee and if he loses it he must replace it at his own expense; if he leaves the company he must turn it in."

This was interesting, but it was getting away from the purpose of our visit, which was to find out how this inventor and manufacturer in the field of fountain pens had made such a success. To get back again we asked:

"How did you happen to get into this business?"

"Like most practical inventors, I was a mechanic," he answered. "I had learned to be a machinist and tool maker in Alsace, where I was born. When I came to this country at the age of 21, I went to Akron, Ohio, because I had about 250 cousins there, none of whom I had ever seen, but all of whom I wanted to meet. It took me six months to visit all of them.

"The B. F. Goodrich Company seemed a rather ideal place for me to work, for a rather unique reason. They had a mighty good employees' band and I wanted to join it. They welcomed me with open arms because I could play four instruments—the flute, the piccolo, the clarinet, and the trombone. In the shop I made more money than any of the other men because I was an expert tool maker.

"AFTER a time I quit. Being young and restless, I drifted to Cincinnati, where I got a job with O. E. Weidlich, manufacturer of fountain pens. Sometimes, when business wasn't so good, he would "hang me up" for my salary. I wasn't very fond of that quaint custom, so I left him to go with John Holland, famous pen maker back in the nineties.

"The Swan Pen Company heard of various things I had been doing to speed up the making of pens and sent for me in 1897 to enter their New York factory. I stayed with them until 1903, when I opened up a little shop of my own to make fountain pens and parts for manufacturers."

"Was there much fountain pen work to do in 1903?"

"Not in comparison with the size of the business today. The fountain pen was still in its infancy. My first order came from Cleveland for ten gross of holders. Then I saw Edward Todd and Company and they promised to buy ten gross a week. The next year I contracted with the Conklin Pen Company. Their first order was for ten dollars' worth of holders. It was so small that I investigated to see if it wasn't a mistake. That was all it was, but two years later I signed a contract

with them for 600,000 holders. At 36 cents per holder that was a pretty big contract for me in those days.

"In 1912 Schaeffer came east and developed his patents. The next year he wanted me to join forces with him and go to Fort Madison. I couldn't see leaving New York and so I passed up my first chance to become a millionaire."

"How did you get orders for pen holders?"

"The manufacturers knew me and every fall I would go on the road, show them some new ideas and come back with orders for 700,000 or 800,000. In 1917 a strike upset the fountain pen business generally, but I was paying my workmen more than others were, so I had little trouble. There were then about 60 men in my factory."

"IF business was going on so smoothly, Mr. Schnell, why did you think of changing your methods?"

"Because I could see that it might not always go smoothly. Do you remember the Dunn pen? It was a big seller several years ago. I had a contract with Dunn for a half million holders. When he failed I lost a lot of money and I realized that it would not only be a lot more profitable but a lot safer to be in business for myself. I began waiting for an opportunity."

"And what was this opportunity?"

"A new product. One day about four years ago a man named Wilhelm came into the factory, showed me a combination pen and pencil and asked me if I could make it. It was almost identical with the model of a combination I had made back in 1892 and then had forgotten about. I got it out of the attic and found the date scratched on it. Wilhelm and I might have had a row about it but we were both reasonable and decided to join forces and look around a bit to see how we could put the combination pen and pencil idea over. I made some new models.

ONE OF THE FIRST STEPS IN MANUFACTURING

Grinding and boring the composition material used in making fountain pens. It takes just 28 seconds to produce a complete combination pen and pencil with modern machinery

"WILHELM was traveling out west. In Dallas he interested Clarence M. Wheeler, a real estate operator, in the idea and Wheeler came east and decided to join forces with me in manufacturing and selling the new combination article, which we decided to call the Penselpen. Wilhelm developed other interests and we bought him out.

"There was a lot of work to be done. The pen holders had to be perfected. Many of them would get broken when the cap was unscrewed. I experimented a bit and fixed that up. I got a patent on a new feed bar. Then I got a patent on a new filling lever, making it easier to fill the pen, than by any method heretofore known. The public took to the new article from the start.

"The clip on the average fountain pen is not durable, so I began groping for a new one. The day Lindbergh took off for Europe the idea came to me. Why not, I asked, design a clip to look like an airplane? I did it. It was a beauty. Not only did it look good, but it wouldn't break, any stress on the shank of the clip being distributed out along the wings. Two days after my patent was issued a lawyer came to the factory and offered me 10,000 dollars for it. Fortunately, I didn't take his offer, for that clip is our biggest selling feature. It sells 75 percent of our holders."

"How many pens have you made altogether?"

"In my time I have made more than twenty million pens. I made three quarters of a million for Dunn, one of my biggest customers."

"How many patents have you taken out?"

"Seven. The first was on an ink feeder. I got that in 1903."

"Did you make money on any of your patents?"

"I made money on all of them."

"How?"

"I WOULD incorporate the new feature on each pen holder and add five or six cents to the price to the manufacturers. They were glad to pay it."

"That has amounted to a good deal of money, hasn't it?"

"Yes, but not enough. In five years I can make more money working for myself than in 20 years not working for myself. That is true of any inventor. I really believe it is safer, too."

We went through the factory. Here was a machine grinding down and polishing tubes for the pen barrels. Water kept playing upon them throughout the operation to keep the friction from overheating them. Next we saw little white rings being sweated on caps for purposes of ornamentation. These rings are a waste product of condensed milk. Now we saw them inserting hard-rubber pen sections, the little

INSTALLING THE RUBBER SAC

In order to utilize the full capacity of the rubber sac, an improved device for filling the pen was invented. Most pens are lost or broken before they wear out

THE INVENTOR-MANUFACTURER IN HIS FACTORY

Mr. Schnell explains that his success as a pen-maker has resulted from introducing a popular new product in a field where the competition was keen and the demand almost unlimited

parts that fit under the gold tips. Over at another machine they were polishing pen barrels made of a combination embodying fish scales; these are the mottled black and white pen barrels which suggest mother-of-pearl, so popular now. Two final polishing wheels, one covered with muslin and one with flannel put the finishing touches on the barrels. These wheels, by the way, are made from parts of Ford automobiles. And so it went, down to affixing the airplane clips, inserting the rubber sacks, adding the pencil tips, adjusting and inserting the gold points, and all the rest of it down to the final inspection.

"How long does it take to make a pen and pencil combination?" we queried.

"Twenty-eight seconds."

"How long would it take one man if he made it all?"

"THERE are only 12 men in the United States who can make a fountain pen complete. Working with all the latest equipment, it would take one of those 12 about three and a half hours. Working without machines, it would take him two days."

"Do people find the combination pen and pencil much more convenient than a pen and a pencil separately?"

"Not only more convenient, but more efficient. One of the banks in New York made a practical test recently with two entry clerks. One man was given a pencil and a pen and one man a combination pencil and pen. In the course of a day, it was found, the man with the combination did 30 percent more work than the other.

"People buy pens for lots of reasons. I know of one man who ships these combinations to Africa every month where they are exchanged for ivory tusks. Sometimes a man will buy a pen because he likes its looks, even if he doesn't need one. Color has an effect on sales of pens. Would it surprise you to know that 85 percent of the red-headed men who buy pens buy red ones? Women buy pens to match their manicure sets. Recently many men have been using two pens, one to go with a desk set and one to carry in the pocket."

"From your experience, Mr. Schnell, would you say that it pays to be an inventor?"

"It has paid me and I believe it would pay every inventor where the same conditions are present as were present in my case. In the first place, the inventor must know his particular industry thoroughly. He must know how things are made and sold and he must be able to judge what will appeal to the public and what will not.

"In the second place, the inventor must be in a field in which there is a big demand. The more competition there is, the better it is for the man with a new idea. And in the third place, the inventor must have adequate patent protection.

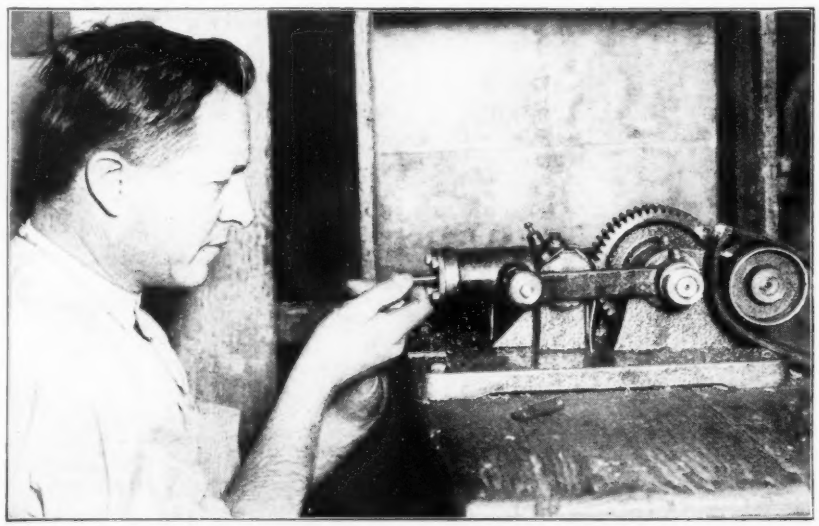
"Yes, there is money in inventing. There is more money, however, in manufacturing. Where the same man is both inventor and manufacturer, and the invention is something the public wants, then that man is sitting on top of the world."

"WHO would you say is the original inventor of the fountain pen as we know it today?"

"That is something that is lost in the dim mists of antiquity. The ancient Egyptians had a kind of stylus which carried its own supply of ink and ever since then men have been trying all sorts of ingenious devices to obviate the necessity of dipping into ink.

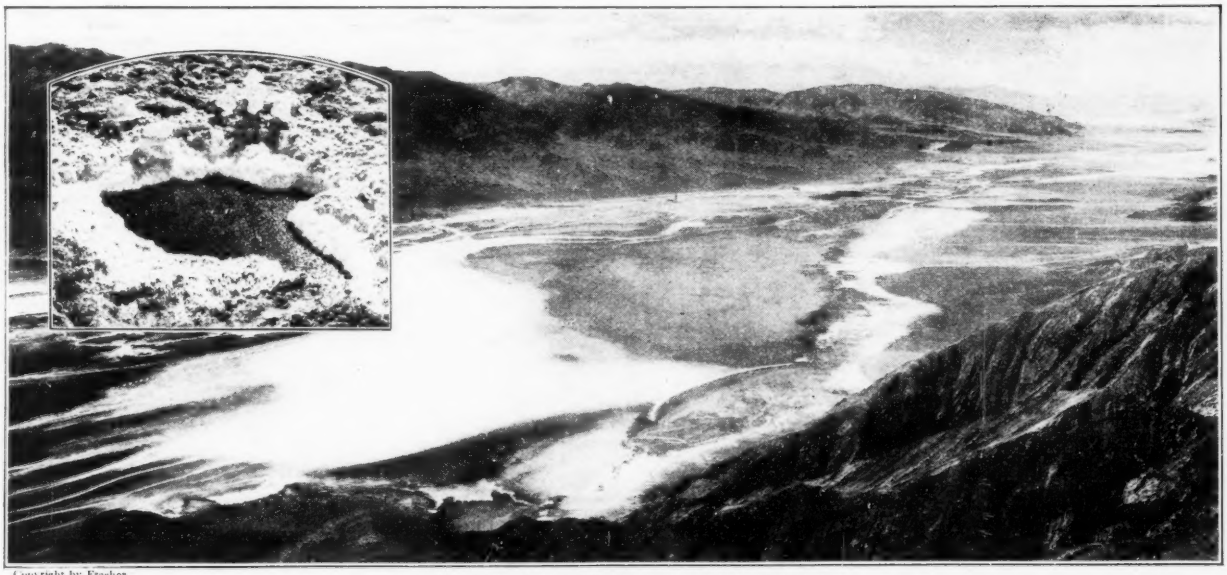
"When Lewis Edson Waterman applied at the Patent Office for his grooved-rubber feed device, he found that about a thousand patents on fountain pens had been issued before his. There have been still more issued since. It isn't the number of changes that are made in fountain pen designs that count, however; it is the merit of the particular invention that marks real progress. Waterman made a distinct advance in the art, and the profits he made were deservedly great. I have reason to believe that I, too, have made inventions that are improvements.

"Inventors sometimes are measured by the number of patents they obtain. I know of one man who has obtained more than 80 patents and has never made a dollar out of any of them. He is not practical. I know other inventors who have concentrated on one invention. They are the ones who have succeeded technically and financially."



SWEATING METAL BANDS ON PEN CAPS

After the bands are attached to the caps, another machine polishes them. The popular black and white barrels for pens and pencils are made of a composition embodying fish scales



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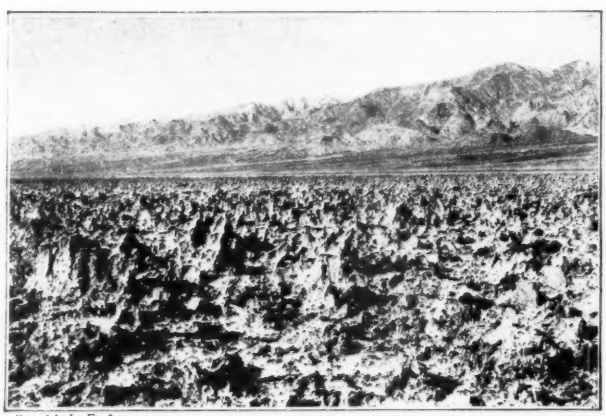
NOT A MIRAGE, BUT THE SANDY FLOOR

What appears to be a great body of water is in fact the sandy floor of Death Valley in California. This majestic picture, showing an area of approximately 70 miles, was taken from Dante's Point. The small inset illustration shows part of one of the salt beds of Death Valley



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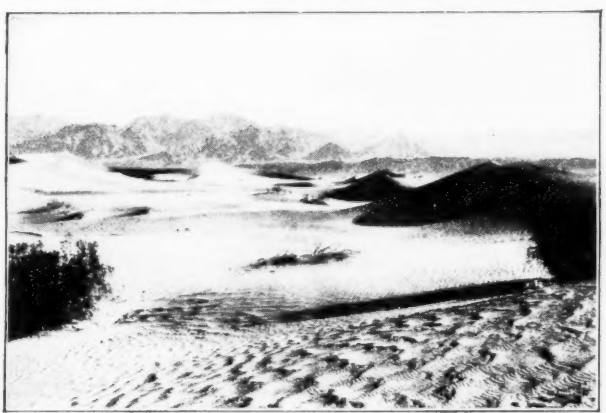
THE DEVIL'S GOLF COURSE

This is a long dusky lava ridge with, in the background, the fanciful fairy-land architecture of the frost king on Telescope Peak



Copyright by Frasher

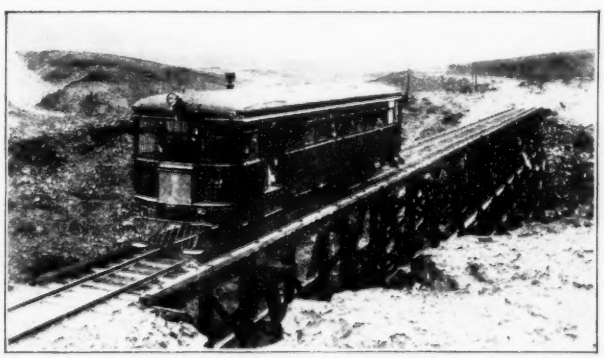
THE SHIFTING DUNES

The dunes of Death Valley assume queer shapes of pyramids and rippled waves. Stunted vegetation holds its own for a time

All photographs courtesy All Year Club of California

TWENTY MULE TEAM DAYS

When the old twenty mule teams were abandoned, the wheels remained as mute evidence of an obsolete means of transportation

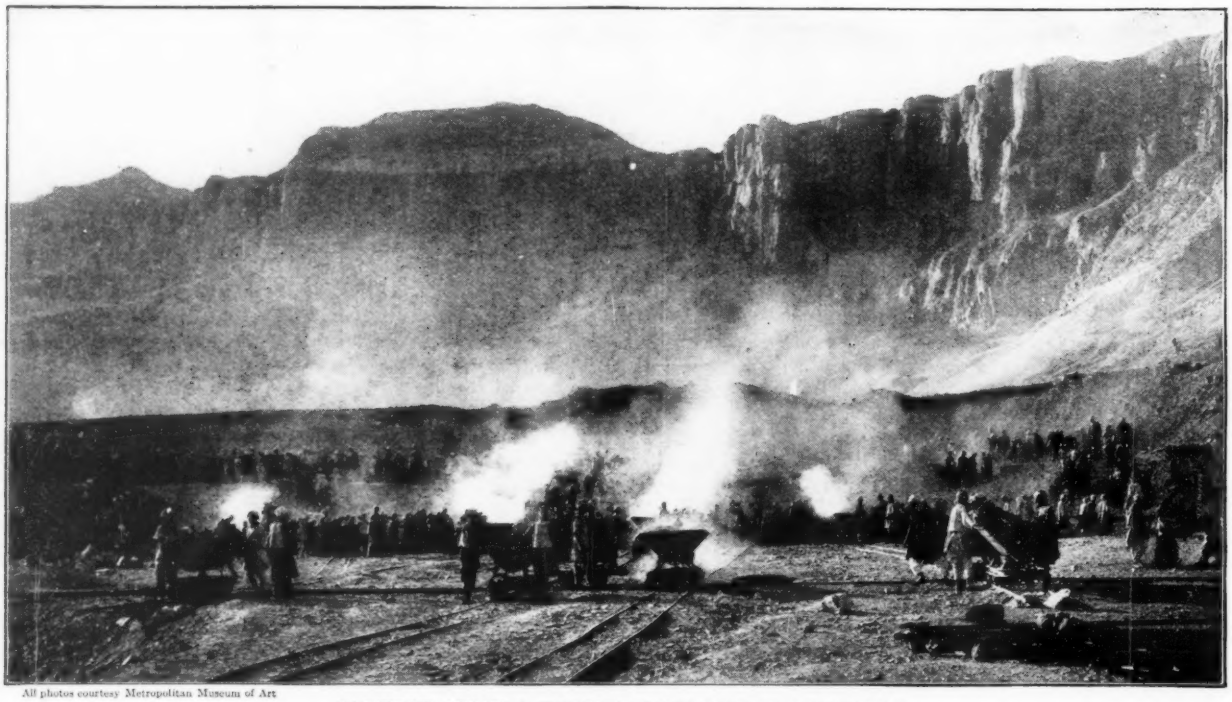


GASOLINE MOTOR COACH

There is a 36-inch gage railway in Death Valley. The gasoline motor coach on rails is admirably adapted for tourist purposes

The Mystery, Desolation, and Grandeur of Death Valley

IN summer, Death Valley is one of the most forbidding places on earth. Nowhere else on the globe do the temperatures range so high in midsummer. It is a torrid, almost lifeless region of barren, burned-sand desert and treacherous salt marshes, a place of sand storms, mystery, adventure, tragedy. In the old days the graves used to bear this epitaph: "He ran out of water." Now, however, tourists are carried about in motor coaches on rails, and in motor busses on roads. Excellent hotel accommodations are offered the venturesome tourist in this strange region.



All photos courtesy Metropolitan Museum of Art

CARTING AWAY A FORMER EXPLORER'S DUMPINGS

When the explorer Naville began to clear the Temple of Deir el Bahri, at Thebes, in 1893, he dumped 1,800,000 cubic feet of dirt. The Metropolitan Museum's expedition had to clear away this dirt to find the broken statues. Picture shows the rail heads and workers

Egyptian Vandalism 3400 Years Ago

How Posthumous Fame was Denied to a Female Usurper of the Throne of Egypt

FROM year to year we chronicle the activities of the Egyptian Expeditions of the Metropolitan Museum of Art. In our issue of January, 1929, we called attention to the adventurous career of Queen Hatshepsut who was the very ancient prototype of Queen Catherine of Russia or the late Empress Dowager of China. Therefore, we shall confine the present article to the Museum's excavations at Thebes which are so graphically described by Mr. Herbert E. Winlock of the Egyptian Department in Section II of the *Bulletin of the Metropolitan Museum of Art.*

In 1893, when Naville began to clear the Temple of Deir el Bahri, he cut a gap through the temple wall, and ran his light railway down to the steep side of the deep burrow-pit where he discharged his cars into the hollow without investigating what lay below, which he was steadily burying still deeper. In this way he disposed of some 1,800,000 cubic feet of dirt. The expedition's task at the beginning of the season was to explore the side of the quarry throughout the 260 odd feet covered by Naville's dumping operations. This meant the removal of about two thirds of the dump and, under it, of a layer of natural drifted sand on the quarry floor which the excavations of the previous year indicated as being less than seven feet thick. This was estimated to mean the moving of more than 1,400,000 cubic feet of dirt. The eastern half of the old quarry furnished an ideal place for disposal.

It was not found necessary to sift or otherwise examine the material dumped by Naville. This made for fast work. Tracks were laid so as to give six or even seven rail-heads at the face of the work. The diggers worked at two levels as shown in our illustration. Seven hundred men and boys were employed at the excavation. Various difficulties which were met are described by Mr. Winlock, and when the camp was closed May 1, 1928, the thermometer was registering 110 degrees in the shade.

THE task of piecing together the fragments was a long job and of course could not be completed in one season. Some of the pieces were no bigger than the tip of the finger, while others had to be handled by derricks as shown on our cover. The story of the finds as told by Mr. Winlock in his own words is as follows:

"When King Thut-mose II died, about 1501 B.C., his place was taken upon the throne of Egypt by his little son, Thut-mose III, and the regency was intrusted to his widow, Queen Hatshepsut. Hat-shepsut was the daughter of King Thut-mose I; she was the stepsister as well as the widow of Thutmose II, and she was not only the stepmother and aunt, but the mother-in-law as well, of Thut-mose III, through his marriage with her daughter, Nefru-Re. And when to all these complicated connections with the throne, she added an indomitable character and an ambitious following among the Theban courtiers, it is not surprising to find that, instead of surrendering her regency when Thut-mose III came of age, Hat-shepsut usurped the titles of a sovereign ruler of Egypt. She claimed to have been declared heir to the kingdom during the lifetime of her father, Thut-mose I, and immediately set about building a temple at Deir el Bahri where she and her father were to be worshipped together.

"For 12 years at least Ma-ka-Re Hat-shepsut was the ruler of Egypt, with Thut-mose III leading as shadowy an existence as a Japanese Mikado under the Shogunate. And then, in

1479 B.C., she died. Immediately the name of the usurper was expunged from the official chronicles and Thut-mose III decreed that every mention of her and every portrait of her should be erased from all visible monuments. Above all, her temple in Deir el Bahri was turned over to the wreckers. The structure itself might not be destroyed because it was dedicated to the god Amun, but her name and her portraits were obliterated from all the walls, and her statues were hurled down and taken away bodily for destruction and buried in every convenient waste space and hollow outside the sacred precincts.

"WHENEVER we told the visitors to our excavations the tale of the destruction of the statues of Hat-shepsut, we could see complacent little smiles at what they, with their mature modern culture, seemed to consider the childishness of the ancient Egyptian. And yet, every once in a while modern man has taken a little fling at inanimate things quite in the spirit of Thut-mose III. Perhaps it is not altogether fair to go so far back as to cite the vicissitudes of the statue of Charles I at the head of Whitehall in London—sold for junk by Parliament under the Commonwealth and bought by an individual who was astute enough to keep it intact until he could sell it back to Charles II at the Restoration.

"More nearly in the spirit of the successor of Hat-shepsut was the affair of the statue of George III in Bowling Green in New York. Not only was it torn down on the night of July 9, 1776, but, to add injury to insult in a way to have delighted the heart of an ancient Egyptian, the lead of which it was made was cast into bullets to shoot at King George's soldiers. Still nearer our own day was the case of the name of "Jefferson Davis, Secretary of War," chiselled off the Washington aqueduct when he became President of the Confederacy. That was, I believe, as official an act of the Federal Government as the erasures in Deir el Bahri were of King Thut-mose III.

RECOVERED FROM THE DUMP

Matching up pieces is exciting business. This is the head of a red granite sphinx

"And finally, even during this last war, the names of everything from Hamburger steaks to royal families were altered in a fervent desire to suppress memories of the enemy, and it was nothing short of a triumph of emotional suppression when the authorities in Washington merely took the statue of Frederick the Great from the terrace of the War College and put it down cellar, instead of converting it into brass shell fuses. Perhaps we are getting a little tamer than Thut-mose III—but we can hardly pretend as yet that his actions are entirely incomprehensible to us, when we find him destroying the statues of his mother-in-law.

"Our discovery of this cache of broken statues at Deir el Bahri promised to be of prime importance. Of course it could not be comparable to the great cache of Karnak, where the statues of that enormous fane had been buried under the Persian conquest. There, in one hole, had been unearthed sculpture which had accumulated throughout the 15 centuries from the Middle Kingdom to the Saite Period. In our find, the statues would be all of one date, and, in fact, of one person—Queen Hat-shepsut—but in that very fact would lie a certain interest. Deir el Bahri Temple had been planned by one man, the architect Sen-en-Mut, and it had been built in one operation with its sculpture an integral part of its design. Even if we could not recover all of its statues and its sphinxes, we stood an excellent chance of finding the greater part of them, and thus of being able to reconstruct Sen-en-Mut's scheme in its entirety. Furthermore even if those statues which we might find should be broken, the breaks would be clean, and easily repaired, and, thanks to their having been buried while they were still new, many of them would still retain their coloring.

"The amount of destruction to which the original wreckers had subjected Hat-shepsut's portraits varies a good deal. Always the uraeus—symbol of kingship—was battered away. Sometimes the face was almost totally destroyed, and at other times only the eyes were pecked out and the nose knocked off. Occasionally, with a smaller statue, they were content merely to break the head off without bothering to damage the features at all. On the whole, the damage is not so disfiguring as it might have been. The two standing statues could be reassembled almost entirely except for their bases. One of the colossal kneeling statues lacks only the base and the two hands.

"IN one respect the mutilation and the burial of these statues have actually worked for their preservation. They were not more than five years old at the time of their removal. They had not been exposed long enough to the elements to become weather-beaten, and their early burial served in many cases to preserve their paint almost intact.

SINK-HOLE IN QUARRY

On the floor of the quarry many fragments were recovered from quantities of earth thrown over them by a former explorer

REASSEMBLING THE STATUES

Here we see the use of American tackle and differential block helping along the slow work of adjusting the pieces of the statues

"Possibly the reader to whom the story of Hat-shepsut is unfamiliar will be somewhat puzzled at the mention of a beard, and at the virile cast to some of these portraits. Now and then we have found heads which can be taken without much question as being feminine, while other statues are uncompromisingly masculine. The explanation lies in Hat-shepsut's ambiguous position. A woman could not be sovereign of Egypt, and if she attempted to usurp the position she must hide her sex from posterity, even if she could not hide it from her contemporaries. It is a commonplace to the student of Egyptian history, therefore, that Hat-shepsut was represented as a king. To the student of Egyptian history our identification of these statues will cause no surprise, and in many cases the inscriptions on them can leave no doubt. Elsewhere throughout the temple the portraits of the founder were on every hand. We are reasonably certain that there were at least 12 little kneeling statues. We know of three large seated statues.

A RECONSTRUCTION

Here we have the reconstruction of a colossal statue nearly 24 feet high

"DEIR el Bahri Temple was not only a shrine of the god Amun; it was, in addition, intended as the temple where the dead Hat-shepsut would receive her provisions for eternity. Dead, she was one with the god Osiris, and hence it was appropriate that she should appear in Osirian guise as a mummy, holding in her hands the crook and flail which Osiris carried. In such guise we have found her portraits continually, and our workroom shelves are stocked with fragments of every description, all of the most brilliantly painted limestone.

"There was an Egyptian funerary custom that we have had occasion to refer to more than once in these reports. After the body had been embalmed and wrapped in its bandages by the undertakers, all of the embalming materials which were left over were gathered up and packed in jars which were carried to the necropolis and buried somewhere near, but never actually in, the tomb.

"When we were digging in the Deir el Bahri quarry, we found that the western end of it had begun to drift up with wind-blown sand as soon as the quarrymen had abandoned it. In the course of time a bank of sand several feet thick had accumulated in a semicircle around the end of the quarry nearest the temple, and as we dug into it we found numbers of large round-bellied jars, stoppered with mud, buried in rows in this sand-drift. When we came to open them, each jar was found to be filled with bundles of natron or of sawdust, with soiled rags, with broken cups which had contained oil, and frequently, with the sweepings of the floors of the embalmers' shops. These sweepings were far from pleasant, even in retrospect, but they gave us some very obvious clues as to the underlying idea in this custom. The Egyptian undertaker was a careless and venal workman and if a person wanted to be sure that the whole of his mortal coil attained a safe burial, it was as well that even the sweepings of the embalming shop floor should be gathered up.

"We had in our storeroom several similar sets of pots from previous years and for days our time was taken up entirely with examining and recording the contents of some 200 such jars, and the baskets and hampers buried with them. Years ago we had found a wooden table which had been used for the embalming of the body of the Wazir Ipy of the Eleventh Dynasty.

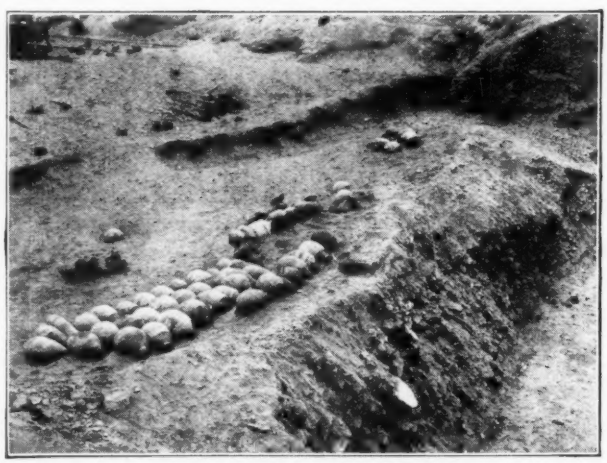
"This year we had to deal with several mats which still bore the stains of the aromatic oils used in such a process. These mats were just the size of the sleeping mats of the modern peasants, and in one case we found a very much crushed, but still recognizable, wicker bed on which some old Theban worthy had been laid out.

"The jars themselves were of several different shapes and often showed signs of having seen hard use before they arrived in the hands of the undertakers.

"PROBABLY just about the time that the pots were being buried—or a little later—some thief who had made a haul in a house in a nearby village was looking for a hiding place for his loot, and lit upon the sand drift in the quarry. He had a cook pot incrusted with soot outside and not so well scoured inside but that there were still some traces of the last dish for which it had been used. He had one of the massive bronze anklets which women of the Meroitic Period affected, and which were so heavy that a rag had to be worn under them to keep them from chafing the wearer's ankles. And he had two curious bent metal tubes, one of iron and the other of bronze. When the latter was brought to New York and cleaned by Dr. Fink (Columbia University) it turned out to have a sieve on one end and was evidently a siphon for sucking beer out of a deep jar."

A WELL-FILLED CLOSET

A corner of the workshop where fragments of statues await assembling as the pieces are found. The results have been remarkable



UNDERTAKERS' WASTE JARS

A curious side-light on Egyptian manners. The jars frequently contained sweepings from the floors of the embalmers' shops

Aerodynamic Wind Mills

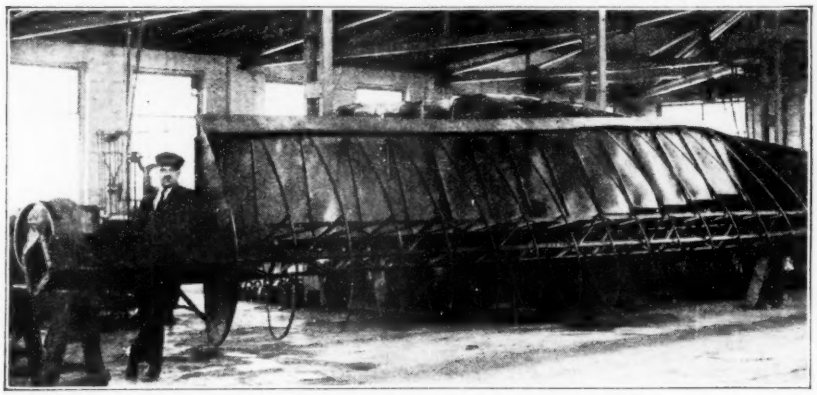
Airplane Science is Applied to Wind Mills for Greater Power and Efficiency

WIND mills of the older countries of the world, and especially of the Netherlands, have for centuries furnished man with free power with which to grind grain, pump water, and do other jobs requiring more power than man could supply. With the advent of the steam engine and of electricity, the inefficient, low-power wind mill was superseded to some extent even though its power was free. In isolated sections or in localities where fuel is expensive and electricity lacking, it has held its own and is still in use. Various improved forms are commonly used in this country.

For the first time in history, however, the aerodynamics of the airplane have been applied to the design of wind mills in order to achieve a higher efficiency. The Kumme system of wind power plants, recently introduced into this country, is of German design based on the researches of Professor L. Prandtl, of Goettengen, and his collaborators, Dr. A. Betz and Dr. Ackert. The blades of the wind wheels of these power plants are shaped to eliminate wind congestion and whirling air currents. Their pitch is regulated by the wind itself—that is, the blades rotate about their longitudinal axes according to the wind pressure. Thus a wheel of this type will generate considerable power even where winds are light. On the other hand, high winds will not wreck one of them nor cause the generator to speed up excessively.

The wind wheels may have diameters up to 60 feet, while the tower must always be so high that the lower edge of the wheel is 14 feet above any obstacle. Two smaller wheels perform the work of a vane in holding the main wheel into the wind. The drive shaft from the wheel terminates in the generator room in a horizontal wheel of large diameter which, in turn, drives the generator by means of a belt. The generated electrical power is distributed to bus-bars on the ceiling of the plant. Excess electrical power is stored in large batteries, and a fully equipped switchboard controls the distribution system.

The Kumme system wind power-plants are built in sizes up to 300 horsepower. They are rapidly coming into use in many parts of the world.

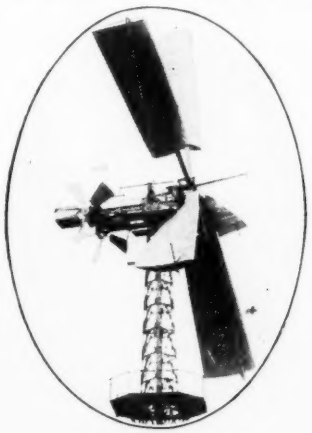


STRUCTURE OF THE NEW WIND WHEEL BLADE

The size of the wind power-plant wheels described here is indicated by this blade which shows method of construction. It is similar in design and construction to an airplane wing

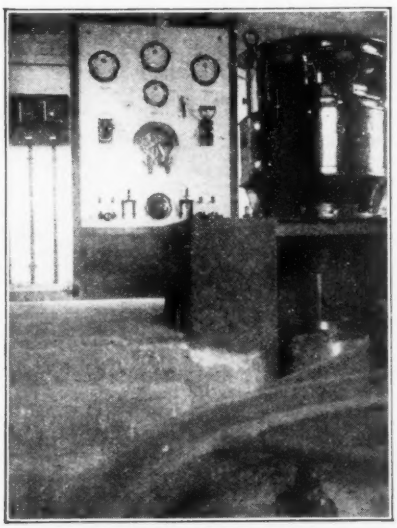
A TYPICAL INSTALLATION

An entire 2000-acre farm in Germany is electrified from this wind power-plant



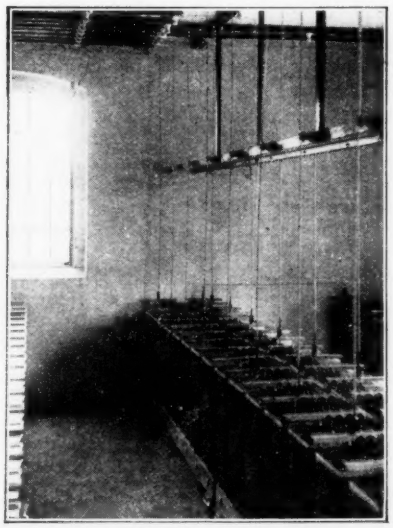
"VANE" WHEELS

The two wheels which hold the main wheel into the wind. Note blade thickness



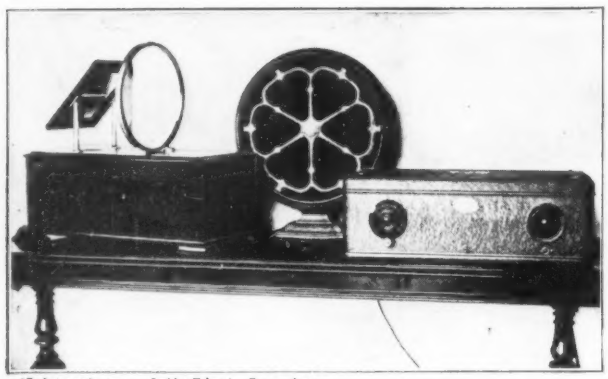
GENERATOR ROOM

The great drive wheel and belt, the vertical-shaft generator, and the switchboard



STORAGE BATTERIES

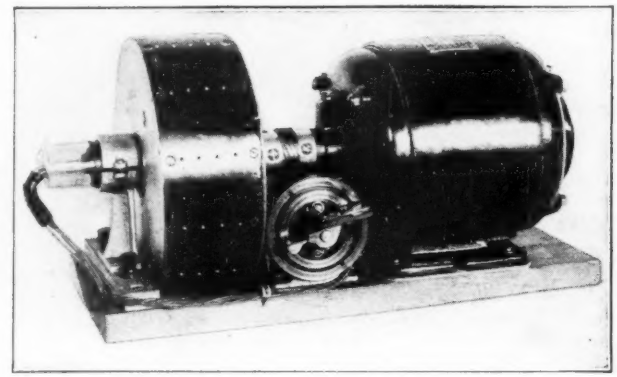
The wheels generate up to 300 horsepower. The excess power is stored in batteries



All photographs courtesy Jenkins Television Corporation

TELEVISION REPRODUCER

At the left of the standard radio receiver and loudspeaker is the vision apparatus. Picture is viewed in the mirror through the lens



MOTOR AND SCANNING DRUM

At the extreme left is visible the end of an unmounted four-element neon lamp inserted in the center of the perforated scanning drum

Television Advances

With Powerful Transmitting Stations Furnishing Radio Vision Broadcasts on Schedule, Receivers Are Being Developed and Tested by Thousands of "Lookers In"

By A. P. PECK

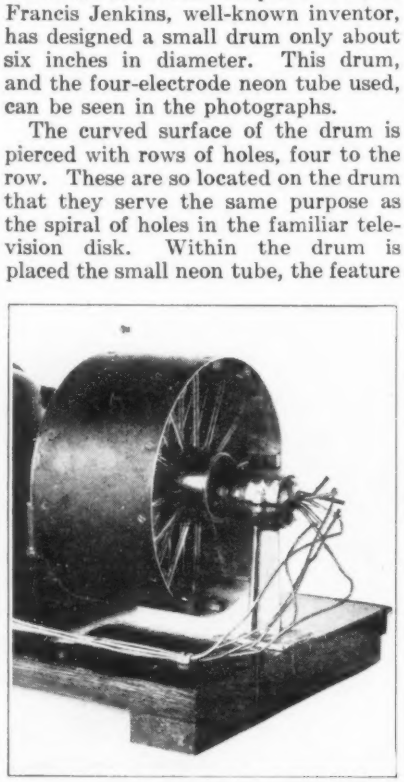
AT about the time that this magazine reaches the reader, there will be in operation in Jersey City, New Jersey, a high-powered broadcasting station dedicated to television. Previously, there have been a few stations on the air with radio vision, but for the most part, these have been using low power and broadcasting for their own experimental purposes. But the new station mentioned is to be put on a regular schedule as soon as possible, and with the high power which is planned, there should soon be many thousands more "looking in" than there are at present.

IT is obvious that the erection of a large transmitter for television purposes would be useless, unless there was a move on foot to supply essential instruments for converting radio receivers designed for broadcast reception to use in television. And this is just what is being done. In the Jersey City plant of the Jenkins Television Corporation, production is going forward on a television unit or "radiovisor" which is designed to be connected to an electric light socket and to a standard multi-tube receiver capable of tuning to the wavelength.

The fundamentals of television are so well known, and have been described at such length in the pages of this magazine* that we will not take the space to go over them again. However, in the Jenkins reproducer, as it stands today, there are many novel points which merit description. In the first place, the point which most impressed the writer when first shown one of the reproducers, was its small size. This has been made possible by discarding the huge disk which has formerly characterized almost all television receivers. In place of it, C. Francis Jenkins, well-known inventor, has designed a small drum only about six inches in diameter. This drum, and the four-electrode neon tube used, can be seen in the photographs.

The curved surface of the drum is pierced with rows of holes, four to the row. These are so located on the drum that they serve the same purpose as the spiral of holes in the familiar television disk. Within the drum is placed the small neon tube, the feature of which is that there are four electrodes from which light may be obtained instead of the usual one. By using this type of tube with a mechanical current distributor, it is possible to illuminate each one of the electrodes in succession with only a fraction of the current which is required for satisfactory operation of the large surface of a single electrode tube. Therefore, such a tube can be operated from a multi-tube radio receiver without the use of a special high-power amplifier.

By employing a mechanical distributor to switch on and off the electrodes of the neon tube as the drum rotates, it is obvious that the specially placed holes will present the appearance of traveling in a spiral. Therefore, if a radio-vision program is being received, and the reproducer is in synchronism with the transmitter, there will be made visible a reproduction of the action at the transmitter.



SILVERED RODS

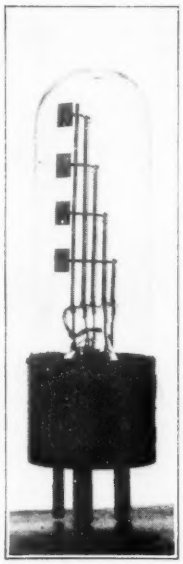
Glass rods, silver plated, conserve the light by direct conduction to the holes

ONE of the vital factors in television reception is the conservation of the light which is used to present the image. Since there is, at best, only a small quantity available, any unnecessary losses will seriously interfere with the efficiency. In the Jenkins "radiovisor," such losses have been reduced by conducting the light from its source direct to the holes in the drum. At first, fused quartz rods were used for this purpose, but their cost and the fact that they were not obtainable in quantities sufficient for production, led to the adoption of glass rods, silver plated. These have been found highly satisfactory, and are now used in all

*See June, 1927, March, 1928, and December, 1928.

the reproducers manufactured. In the Jenkins "radiovisor" shown, a large lens is used to magnify the image somewhat, and to enable more than one person to view the "radio movie" at the same time.

Possibly some of our readers have wondered at the writer's choice of the word "reproducer" instead of some such term as "television receiver." It must be stressed that any good radio receiving set is a potential television receiver. If it can tune to the wavelength on which television is being transmitted, and has a high-quality amplifier capable of passing a broad band of frequencies, it can be used with perfect satisfaction for television work. The only necessary adjunct is a television "reproducer" which is to be connected to the set in place of the loudspeaker—or possibly at the same time as the loudspeaker, when vision and voice are broadcast simultaneously. This reproducer, then—or might we call it a "visual loudspeaker"?—is what is now being produced for the future entertainment of the radio public.



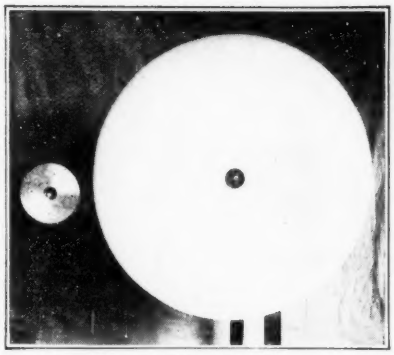
NEON TUBE ➤

Four electrodes are used, but are not illuminated simultaneously. A current distributor feeds them in proper sequence

The transmitting equipment which is being used at the present time by the Jenkins company is interesting, as it makes use of motion-picture films and not actual settings and actors. At the time of writing, these films are made in black and white—silhouette—and not in shades of gray, as is the standard motion-picture film. They might be likened, in fact, to the animated cartoons with which all motion picture fans are familiar. These films are fed through a device which modulates the out-going radio wave. This device is shown in one of our illustrations. The film moves through it with a steady motion, and not the intermittent motion of a "movie" projector. As the film moves past a narrow slit located at a point where the film is bent in an arc of short radius, light reaches the surface through the holes in a scanning disk. This light passes through the film and acts on a photoelectric cell, causing a current to flow in the circuit of the cell. This current varies in strength according to the opacity of the film, and therefore can be used to modulate the carrier wave.

THAT television will repeat all over again the progress of sound broadcasting is a rather safe prophecy. For years, the fundamentals of broadcasting were known. Then music was put on the air. The only listeners were the comparatively few amateurs who were dabbling in radio—wireless—for their own entertainment and personal knowledge. They took up this new toy of voice reception with their usual thorough-going enthusiasm, and soon the public became convinced that radio broadcasting was something worth looking into. From then on, the development makes a story familiar to all. Without a doubt, the story of television will be much the same. With thousands of television reproducers in various locations throughout the country, much valuable data will be accumulated and this data will help to point the way to future improvements.

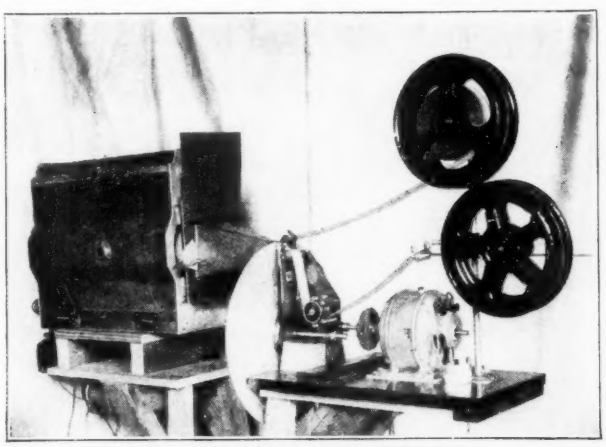
Although it has been said that the building of radio receivers in the home is dying out as a hobby, this may be only the natural result of perfection in manufacture. At the present time, it cannot be said that the same is true of television. There is no perfection, and such can be looked for only in the future. In the meantime, there are on the market, in addition to the complete receivers mentioned, kits of essential parts for the construction of simple television reproducers of the standard scanning-disk type. These contain the hard-to-get parts and enable anyone with some mechanical skill to build a reproducer which will give some interesting results.



A COMPARISON

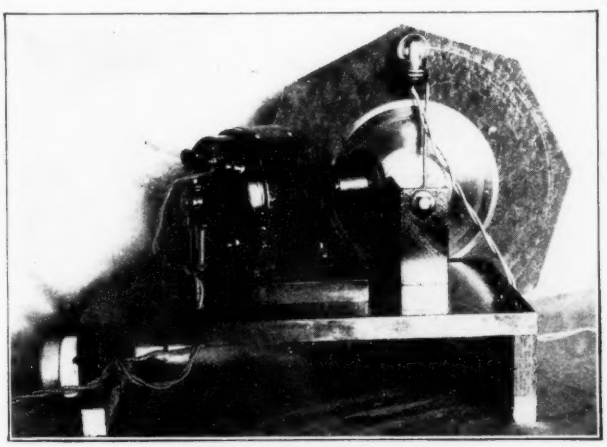
At left is the small, compact scanning drum; at right is an old-fashioned disk

RADIO experimenters and others interested in television, but unfamiliar with the present status of the work, must be warned not to look for perfect results or large pictures which can be shown to a group of admiring friends. The pictures so far reproduced with apparatus which is available for home use are small—in the neighborhood of one by one and one half inches—and often are not any too clear. But things like this are no deterrent to progress. Pictures can be received, and it will not be long before they will be bigger and better, and will approach perfection.



RADIO "MOVIE" TRANSMITTER

The motion of the film is continuous, not intermittent as in motion-picture projection. The disk is perforated with a *circle* of holes



AN AMATEUR RECEIVER

The scanning disk, neon lamp and support, disk shaft and bearings, and the friction-disk are now available in kit form at a low price

Protecting Paintings for Posterity

Various Branches of Science Are Combining to Foil the Arts of the Faker of Paintings

By FRANCIS P. MANN

FORGERIES of paintings often occur during the lifetime of the artist and at his or her death spurious pictures begin to appear on the market, if the works of the deceased painters are in demand. Posthumous fame is dear to all artists and a French society makes it possible to register a painting during the lifetime of the artist, and so provide a pedigree in writing, authenticating X rays, and photographs which will prevent any dispute at any time. This is the Société du Droit d'Auteur aux Artistes, or Society for Artists' Copyright. It is intended to protect the artist against all fraudulent practices in the way of imitations of his works.

REGISTERED

A certificate is issued and an enlargement is made of a certain part of the painting

This identification of a painting is made by calling upon all the varied resources of modern science and by the use of improved apparatus which is often specially designed for the purpose. It is the reverse of the process described in our issue dated May 1929.

The society has assembled various technical experts who have already evolved highly valuable methods of research based upon the most modern scientific practice. This led to the founding of a special registration department, by which all works submitted by an artist could be examined and various records could be made by photography or X rays, or other scientific methods. Thus, each picture is given its exact identification. All the data and results for the picture are put on file, and an "identity certificate" is made out, of which the artist is given a copy. This record accompanies his picture on all occasions.

The documents on file, as a result of the laboratory examination, include various scientific records. The first of these is an ordinary photograph of the picture or other work. Then there is what is called a "metro-photograph," which is an enlarged photograph of a small square which is carefully located on the painting and is accurately measured from the edge of the painting. This small square is photographically enlarged and is valuable as identifying the brush strokes and all details.

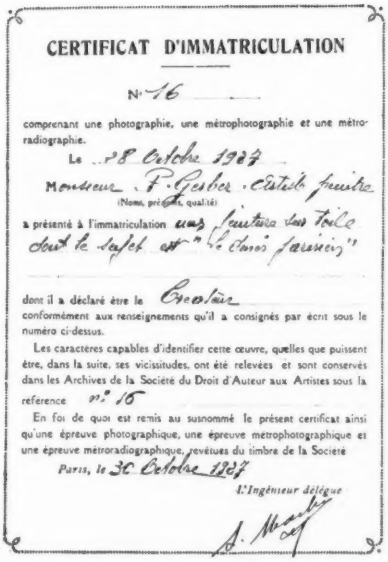
What is known as the "metro-radiograph" is a record of a like square, but photographed with X rays which are directed through the picture upon a photographic plate. Between this and the ordinary photograph there is a striking difference, and this affords another means of identifying the painting and of conferring upon it the individuality which is the object of this system. Each photographic print is stamped with the official seal of the society.

In the future, if there is any doubt as to the identity of a picture, it is referred to the society, where it is turned over to the laboratory. Usually a comparison with the "metro-photograph" will show up any differences, for all details are much enlarged. If there are still doubts, the picture is examined by X rays. This also shows all the faults and irregularities of the weave of the canvas. Two pieces cannot possibly be alike in such respects, and therefore the X rays form an excellent source of comparison in this respect. A suspected picture is X rayed, and the X-ray photograph of the original is examined to see whether the two photographs match as to the texture of the canvas. If so, this is undoubtedly the real picture; if not, it is a copy.

UP to the present time, in France, this class of research has been confined within the limits of judicial investigations, and to the special laboratory practice with which the name of Bertillon is associated. In other countries the same rule seems to hold, and it is only when matters are brought up in court that the judicial

THE PHOTOGRAPHIC ENLARGEMENT

Compare this illustration with the center part of the one showing the entire painting. Every brush mark and personal idiosyncrasy of the artist is visible for identification



CERTIFICAT D'IMMATRICULATION

N° 16

comprenant une photographie, une métrophotographie et une métroradiographie.

Le 28 Octobre 1927

Monsieur P. Gesber artiste peintre
(Noms, prénoms, qualité)

a présenté à l'immatriculation une peinture sur toile dont le sujet est "le Christ parmis"

dont il a déclaré être le Créateur

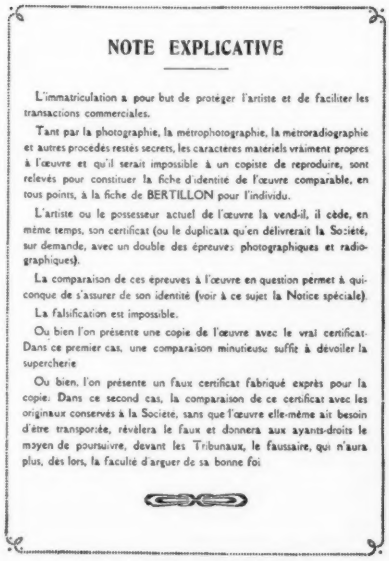
conformément aux renseignements qu'il a consignés par écrit sous le numéro ci-dessus.

Les caractères capables d'identifier cette œuvre, quelles que puissent être, dans la suite, ses vicissitudes, ont été relevées et sont conservés dans les Archives de la Société du Droit d'Auteur aux Artistes sous la reference n° 16

En foi de quoi est remis au susnommé le présent certificat ainsi qu'une épreuve photographique, une épreuve métrophotographique et une épreuve métroradiographique, revêtues du timbre de la Société

Paris, le 30 Octobre 1927

L'Ingénieur délégué



NOTE EXPLICATIVE

L'immatriculation a pour but de protéger l'artiste et de faciliter les transactions commerciales.

Tant par la photographie, la métrophotographie, la métroradiographie et autres procédés restés secrets, les caractères matériels vraiment propres à l'œuvre et qu'il serait impossible à un copiste de reproduire, sont relevés pour constituer la fiche d'identité de l'œuvre comparable, en tous points, à la fiche de BERTILLON pour l'individu.

L'artiste ou le possesseur actuel de l'œuvre la vend-il, il cède, en même temps, son certificat (ou le duplicata qu'en délivrerait la Société, sur demande, avec un double des épreuves photographiques et radiographiques).

La comparaison de ces épreuves à l'œuvre en question permet à quiconque de s'assurer de son identité (voir à ce sujet la Notice spéciale).

La falsification est impossible.

Ou bien l'on présente une copie de l'œuvre avec le vrai certificat. Dans ce premier cas, une comparaison minutieuse suffit à dévoiler la supercherie

Ou bien, l'on présente un faux certificat fabriqué exprès pour la copie. Dans ce second cas, la comparaison de ce certificat avec les originaux conservés à la Société, sans que l'œuvre elle-même ait besoin d'être transportée, révélera le faux et donnera aux ayants-droits le moyen de poursuivre, devant les Tribunaux, le faussaire, qui n'aura plus, dès lors, la faculté d'arguer de sa bonne foi

THE CERTIFICATE

A certificate is issued with each painting which is registered. A copy of this is given to the artist and is to accompany the painting at all times. The original of the certificate is then filed with other data, including photographic enlargements and X rays such as those shown herewith

laboratories are called upon to furnish their proofs. Considering that these researches are the work of persons especially skilled in the field of scientific judicial research, it is evident that the resources of science should be applied in like manner to the protection of works of art.

The various persons who are interested in this field are artists, collectors of art works, directors of art galleries, art experts, antiquarians, dealers, and others. It is only reasonable that these interests, which often represent much capital and are often required to deal not only with questions of art but also with matters of great financial importance, should be able to avail themselves of the resources afforded by our skilled scientific experts. As will be seen, this will put the expert examination of works upon an entirely new basis in the future.

REGISTERED PAINTING

The dotted rectangles indicate the parts to be photographically enlarged and X rayed. See the illustrations above and at left

X RAYED

The lower rectangle in the center photograph, as revealed by the penetrating eye of the X ray. Note texture of the canvas

The methods employed have been largely referred to in the article entitled "Scientific Examination of Paintings," in the May, 1929 issue of the SCIENTIFIC AMERICAN. Referring to all these methods, it is evident that they will greatly increase the means at the disposal of the expert, for they will give him means which the unaided eye could not afford. However, a laboratory of this kind is necessarily incomplete, for other methods with their several types of apparatus will, of course, be brought out in the future for further applications of science to the examination of works of art.

In conclusion, it may be stated that the modern expert examination of paintings will bear upon the following points: Nature of the fiber of the canvas; Nature of the impurities contained in the canvas; Comparison of the canvas of two pictures; Nature of the wood panel and comparison of two panels; Tears and holes in the canvas

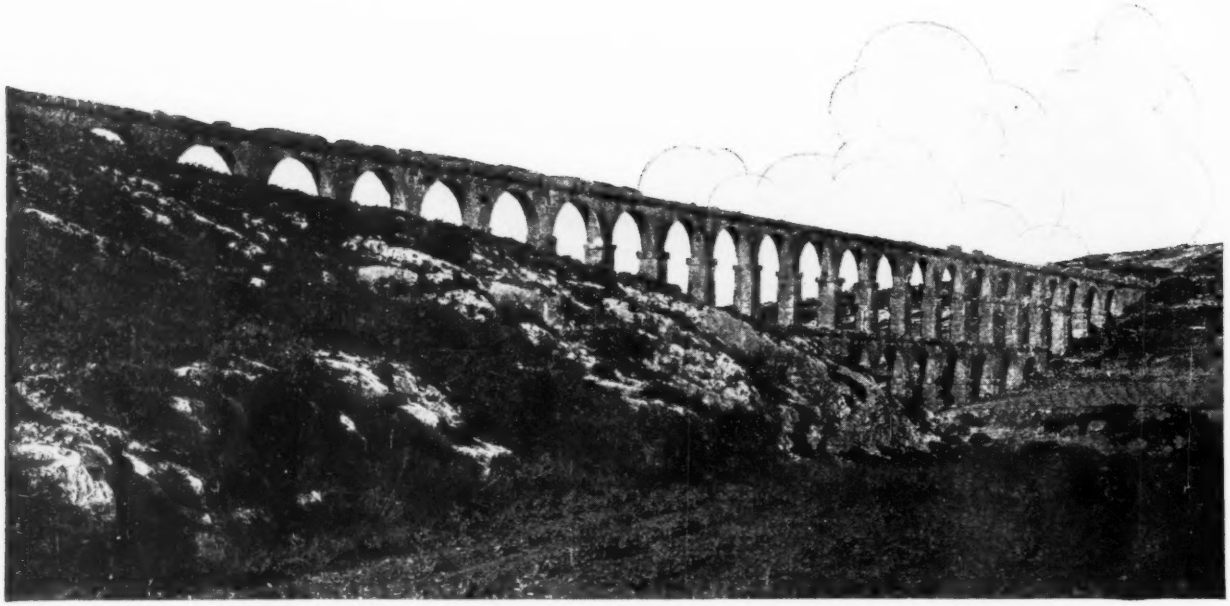
PHOTOGRAPHED

The upper rectangle in the illustration at the left, as it appears when it is photographically enlarged

and restored places; Coating on the canvas or panel; Mineral matter in such coatings, lime, lead, or others; General nature of the pigments, such as mineral colors, lakes, organic colors, or the like; Constituents of the colors; Comparison and identification of two colors; Picture repainted or made over (or changed in parts); Restorations; Picture painted underneath; Picture scraped or over-painted by another artist.

This is an age of great suspicion and we are constantly hearing of spurious works of art being ejected from their high estate in museums or private collections. We must differentiate between the imitator or the copyist who frankly sells his wares as such, and the faker. Ethically, there is a strict line drawn between the imitator and the more or less artistic faker who is a forger with what we might call a "college education" in his particular line.

We are indebted for the above information to the Société du Droit d'Auteur aux Artistes, of which the leading spirits are its director, M. Georges Delavenne and its secretary, M. Duchemin; also M. Frantz-Jourdain, its president and the eminent chief of this modern art movement.



ROMAN AQUEDUCT AT TARRAGONE, SPAIN, AS IT APPEARS TODAY

With a history dating back to the days of Julius Caesar, Tarragone possesses this example of aqueduct construction. It is 22 miles long, partly underground. It was restored to use between 1780 and 1800. Other Roman aqueducts still carry water as of old

Roman Engineering Triumphs

Vast Systems of Aqueducts Built by Roman Emperors Have Commanded Much Admiration From Ancients and Moderns Alike

UPON the traveler whose imagination plays against a background of Roman history, the aqueducts of the Eternal City exercise a never-ending fascination. Those old Romans made both war and peace in an heroic manner. Their legions and their ships of offense moved with a conquering cadence while their architects and engineers thought and wrought in the scale of immortality. On the bloody sands of the Flavian Amphitheater the gladiators saluted Caesar with "Morituri, salutamus," but the Coliseum itself has always seemed to say, "Ave, Roma Immortalis." And the aqueducts, marching across the Campagna "to take part, by fountains, in this Roman triumph," seem to utter the same proud phrase.

In Rome, as in the empires that preceded Rome, tremendous expenditures of brain, time, and labor were made to solve the primary problem of water supply. But Rome, far more than the precedent empires, gave to water all that she could command of art in order that hydraulic engineering might be beautiful.

Roman architecture has been endlessly acclaimed, but Roman engineering has not always received its due. "In comparing Greek and Roman aqueducts," wrote Thomas Ashby, director of the British School of Archeology at Rome, "many writers have enlarged on the greatness of the latter as an example of Roman contempt for natural obstacles, or even of Roman ignorance of the laws of nature. Now, in the first place, the Romans were not unacquainted with the law that water finds its own level, and took full advantage of it in the construction of lofty fountains and the supplying of the upper floors of houses. That they built aqueducts across valleys in preference to carrying pipes underground was due simply to economy.

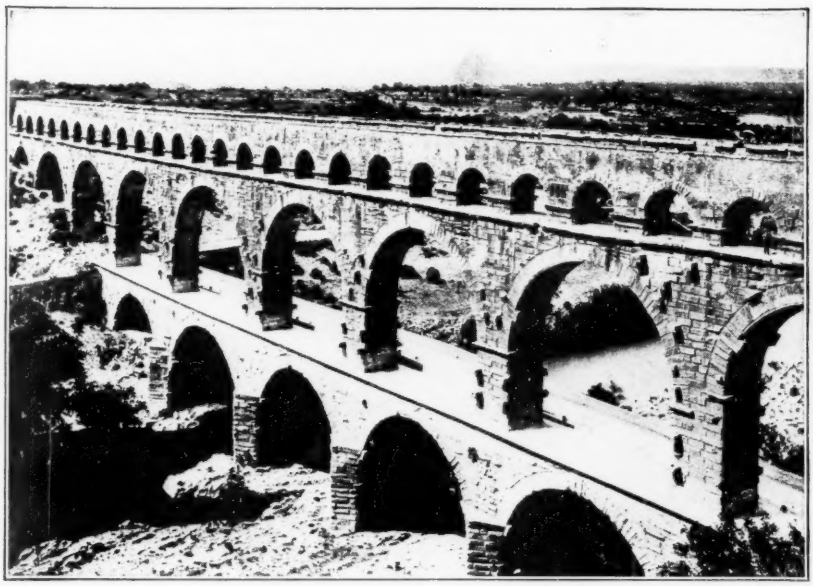
"PIPES had to be made of lead which was weak, or of bronze which was expensive; and the Romans were not sufficiently expert in the casting of large pipes which would stand a very great pressure to employ them for the whole course of a great aqueduct. Secondly, the water was so extremely hard that it was important that the channels should be readily accessible for repair as well as for the detection of leakage. Moreover, the Roman aqueducts did not, in fact, preserve a straight line regardless of the configuration of the country. A striking example is the aqueduct of Nemausus, the springs of which are some 10 miles from the town, although the actual distance traversed is about 25. Other devices, such as changing the level and then modifying the slope, and siphon arrangements of various kinds were adopted (as in the aqueduct of Aspendus)."

There were 11 aqueducts in use during the height of Rome's greatness. The water-carrying channels of these aqueducts varied a great deal in size at different points of the line. Anio Novus is the largest, being from three to four feet wide and nine feet high to the top of its pointed roof. They are lined with hard cement containing fragments of brick. Concerning their capacity, Mr. George E. Tonney, of the engineering department of Spring Valley Water Company of San Francisco writes:

"The discharge capacity of the total of these aqueducts is extremely problematical. Estimates and calculations made by different engineers vary from 60,000,000 to 400,000,000 gallons per 24 hours. Herschell, an American engineer, makes the estimate of 84,000,000 gallons, 54,000,000 used within the city and 30,000,000 without. He calculated that the Claudia and the Novus each could carry 16,800,000 gallons. The daily consumption in the city he put at 20,000,000 gallons, or 38 gallons per inhabitant."

"All the aqueducts," wrote Ashby, "ended in the city in huge *castella*, or reservoirs, for further distribution.

Vitruvius recommends the division of these into three parts—one for the supply of fountains, one for the public baths, and one for private consumers. . . . Besides these main *castella*, there were also many minor *castella* in various parts of the city for sub-distribution. To allow the water to purify itself before being distributed in the city, filtering and settling tanks (*piscinae limariae*) were built outside the walls. These *piscinae* were covered with vaulted roofs, and were sometimes on a very large scale, as in the example still preserved at Fermo, which consists of two stories, each having three oblong basins communicating with each other; or the *Piscina Mirabilis* at Baiae, which is covered by a vaulted roof, supported on 48 pillars, and perforated to permit the escape of foul air. Stairs lead to the bottom of the reservoir. In the middle of the basin is a sink to collect the deposits of the water. The walls and pillars are coated with a stucco so hard as to resist a tool."



PONT DU GARD, NIMES, FRANCE

A strikingly beautiful piece of Roman aqueduct architecture, in a fine state of preservation. For comparison of size, note the man standing on the second tier at the extreme right

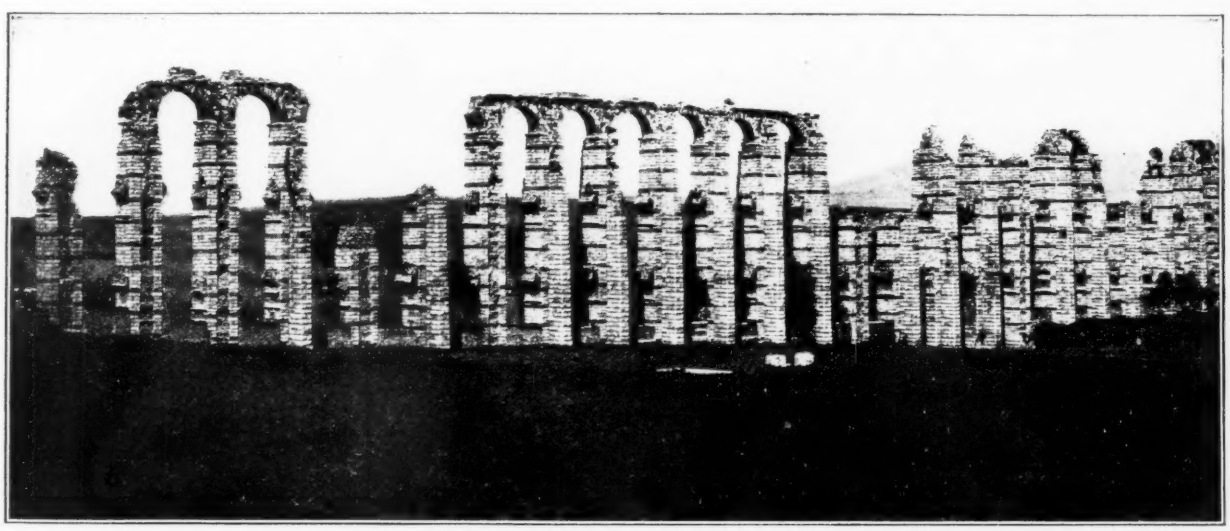
CONCERNING the materials used in the Roman aqueducts, and certain engineering features, William Matthews is our authority.

"The materials employed were different even in the same aqueduct; and in constructing an arch of the Aqua Marcia there were used three kinds of stone, one reddish, another brown, and a third of an earthy color. The Aqua Claudia was constructed with beautiful hewn stone, while others were built with bricks and a strong cement, which so firmly united them as to render the work almost a solid mass. Moreover, the Aqua Appia differed from the others, by having a peculiar construction of width as it approached the point where the water was disembogued for use in the city.

"Although several of the Roman aqueducts might have been constructed in a straight line, yet it is remarkable that their contrivers adopted a sinuous course with numerous windings. Various plausible reasons have been suggested for their preference of such a devious track, some presuming its chief object was to avoid the expense of erecting arcades of great height and solidity, while others have inferred that it solely had in view the preserving of a gentle and equable current for the water. The latter reason appears to be both plausible and cogent, for if the velocity had been considerable, the strong and impetuous motion of the water would have kept it in a turbid state continually, and consequently rendered it unsuitable for drinking purposes. However, another important circumstance demanded peculiar attention and consideration; this was the prevention of injury to the aqueducts from the constant irritation produced by the force and motion of a very quick current upon the bottoms and sides of their channels, for the repairing of such dilapidations would inevitably be attended with great inconvenience."

The Roman aqueducts did not have to wait until modern times to command admiration. Men who saw them building were deeply impressed. Thus, Pliny wrote:

"If any person shall very attentively consider the abundance of water con-



AQUEDUCT MERIDA AT MERIDA, SPAIN

Founded in 23 B.C., Merida flourished and came to be known as "the Spanish Rome." Its ruined aqueduct shows three tiers of arches, the abutments of which are visible here. The decorative effect was obtained by layers of bricks between granite blocks

THE FAMOUS ROMAN AQUEDUCT AT SEGOVIA, SPAIN

This structure dates from Augustus. It was partly destroyed several times and finally rebuilt by Isabella the Catholic in medieval times. It was built without mortar or clamps

veyed to the public, for baths, fishponds, private houses, fountains, gardens, villas, conducted over arches of considerable extent, through mountains perforated for the purpose, and even valleys filled up, he will be disposed to acknowledge that nothing was ever more wonderful in the world."

For Agrippa, who built Aqua Julia and Aqua Virgo, Pliny has a special admiration, stating that "in the course of one year he actually formed 70 pools, 105 fountains and 130 reservoirs, besides adorning all these works with several hundreds of marble statues and columns."

Modern scientists have been equally enthusiastic. Thus, Professor Leslie wrote in his "Elements of Natural Philosophy:" "These works were executed in the boldest manner; nothing could resist the skill and enterprise of the Romans; they drained whole lakes, drove mines through mountains, and raised up the level of valleys by accumulated arcades. The water was kept cool by covering it with vaults, which were often so spacious that, according to Procopious, who wrote in the time of Belisarius, a man on horseback could ride through them. So abundant indeed was the supply as to induce Strabo to say that whole rivers flowed through the streets of Rome."

Aqua Claudia, one of the most famous of ancient Rome's 11 aqueducts, was begun by the Emperior Caligula in 38 A.D. and completed by the Emperior Claudius in 52 A.D. Its farthest spring, the Fons Albudinus, was about 45 miles from Rome. It crossed ravines and tunneled hills until within seven miles of the city, entering upon a magnificient line of arches.

The ruins of Aqua Claudia form one of the most conspicious features of the Campagna. Although finished in 52 A.D., restorations and repairs were found necessary under Emperor Vespasian in 70 A.D. and Emperor Titus in 80 A.D. This surprising need is laid either to hasty or to dishonest construction—the inscriptions recording the fact are discreet.

The most important Roman aqueducts in Spain are those of Segovia, Tarragona, and Merida.

From its mountain sources the water destined for Segovia is carried part of the way in an uncovered conduit, then underground to a reservoir on a height above the city. Beyond this is the aqueduct proper, 2400 feet long, with 109 arches of fine masonry in two tiers, reaching the height of 102 feet.

THE section of the Roman aqueduct at Segovia, at the left, called El Puente, traverses a deep valley, the suburbs, and part of the city. Dating from early Roman times, it was restored under the Flavians or Trajan. It was partly destroyed when the Moors beseiged Segovia in the 11th Century, but was rebuilt by Isabella the Catholic and dedicated to the Blessed Virgin and St. Sebastian.

Of this Segovian aqueduct, William Mathews wrote: "This fine structure is remarkable for its solidity and excellent masonry. Fortunately, this admirable relic of antiquity has withstood equally well the devastating violence of barbarians and the powerful attacks of inclement seasons, through a long series of ages. The design is strikingly light and beautiful; and its aspect has not only afforded gratification to architects but has also puzzled antiquarians who have entertained different opinions with regard to the epoch of its construction—some ascribing the merit of erecting it to Trajan, and others to Hercules, for it has no inscription to determine the period in which it was built."

THE BEST KNOWN OF THEM ALL

One of the most famous of the Roman aqueducts: the Aqua Claudia, which once stretched impressively across a wide valley

A CLOSE-UP OF AQUA CLAUDIA

The rugged construction of this great water-carrying "bridge" is clearly discernible in this illustration. Note tunnel channels

A TYPICAL LIGHT AIRPLANE

Lady Mary Heath in the rear cockpit of the type of airplane in which she made a solo flight from Capetown to London, a distance of 8000 miles. She also established a light-plane altitude record when she attained a height of over 18,000 feet

More Details About

Our Light-Airplane Design Contest

THAT this is the Airplane Era cannot in the least be doubted, for aside from the commercial activity with its many millions in consolidated interests, new airports are springing up everywhere under civic promotion, commercial necessity, and private enterprise—the latest of which is that of real estate developments using airports for promotion propaganda.

Our light-airplane design contest, conceived to stimulate interest and advance in private flying, was enthusiastically received when first announced, but no one connected therewith would have been bold enough to predict that within such a short time we would receive eighty entries; the number in hand as this is written.

As this is a contest based on points given for excellence in various stipulated essentials, we want to make it clear that should a tie result for the first prize, the committee will award the full amount of the prize to each individual so tieing for first place.

Quite a few questions have been asked by entrants to the contest and we answer them here as they may be of interest and value to some others who did not think to bring them up:

Q. What scale for drawings does the Committee favor?

A. Three view drawings should be to a scale of 1 inch to the foot, or better still 1½ inch to the foot. Layouts 1½ inch to the foot. Power plant and installation diagrams 1½ inch to the foot.

Q. How far off center is the crankshaft?

A. As the propeller is mounted on an extension of the crankshaft, the latter must necessarily be on center.

Q. What is the length of the propeller?

A. This varies with the pitch between 6 and 7 feet, the average being 6½ feet overall.

Q. What is the propeller rotation?

A. The rotation is clockwise as observed from the cockpit.

Q. To what extent do you require the investigation of "stress analysis" and preliminary performance calculations?

A. Wing stress analysis should be made for high and low incidence condition only. Fuselage analysis for high and low incidence condition and level landing condition. Chassis for level landing and three point condition. No other stress analysis need be carried out. Performance calculations need only be presented on the basis of accepted empirical formulae.

Q. Can groups of individuals such as flying schools or aeronautical engineering students submit a design for the group?

A. Yes, for such groups are not different in essential status from a company or corporation.

Q. Must the design submitted be for a single-motored plane?

A. Yes, the contest is restricted to a two-seated single-motored plane.

Q. Must the design be for a land plane?

A. The Committee places no restriction on the type of design except that the fuselage shall be of metal.

Q. Can more than one project be submitted?

A. There is no restriction as to the number of designs which can be submitted by an individual.

Q. Shall I submit a model of my design?

A. Models are not required, but the results of a tested model would materially aid the Committee.

Q. What are the Department of Commerce requirements?

A. These can be obtained from Bureau of Aeronautics, Department of Commerce, Washington.

Submissions will not be received after August 15, 1929.

A FAMILIAR SIGHT IN THE SOUTH

Inadequately covered, loosely packed bales of ginned cotton are left outdoors exposed to the weather for months at a time due to lack of warehouse space. The staple deteriorates and much of it is torn from bales and wasted

Wasteful Cotton Baling Methods

Southern Farmers Retain Old Methods Despite the Fact That Much Waste Results. A More Efficient Method Exists and Is Slowly Coming Into Use

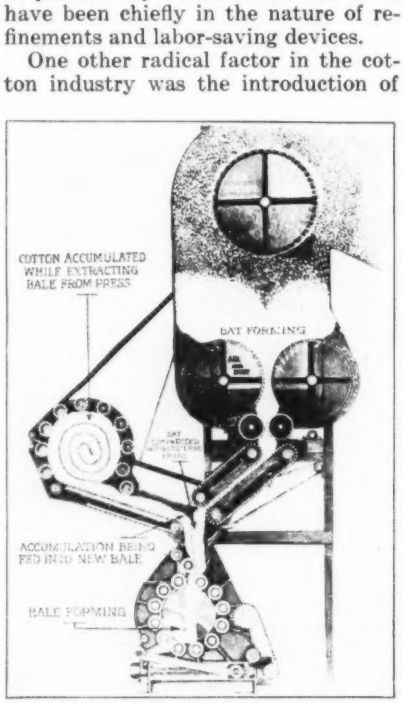
By H. D. MARTIN

THE South has always been "the land of cotton," but down through many generations there have been but few important changes in the methods of gathering and marketing the crop. It is gathered today by hand as it has always been. In an average crop of 15,000,000 bales, the human fingers must pluck from the open boll every fiber and seed and convey to bags 22,500,000,000 pounds within an average picking season of four months. Fortunes have been spent in efforts to produce a successful cotton picker, but thus far, there are none in commercial use.

COTTON was first packed and shipped to the mills of Lancashire in gunny sacks which were called "bags." When these were found too bulky in the hold of the sailing vessels, the "bale" was devised by packing in a box press, partly covering with heavy jute, and tieing with ropes. The single difference between the primitive bale and that of today is the substitution of iron bands, or ties, for the ropes.

The event that has had the greatest influence upon the cultivation of cotton was the invention of the cotton gin by a New England school teacher, Eli Whitney, in 1793, and it is interesting to note that the Whitney principle of separation of lint from seed by the saw gin is the one generally employed throughout the United States today. True, there have been improvements in present-day construction but these have been chiefly in the nature of refinements and labor-saving devices.

One other radical factor in the cotton industry was the introduction of the "compress," the purpose of which is to reduce in size, by hydraulic compression, the plantation bale as it comes from the gin. The function of this device is to economize space in transportation through gin compression. It was used widely during the World War, at a time when there was a great dearth of rolling stock and bottoms. And while today there is no such emergency to necessitate its use, it is none the less a sad commentary on our progressiveness that even the exigencies of war could not eradicate indefensibly wasteful methods.



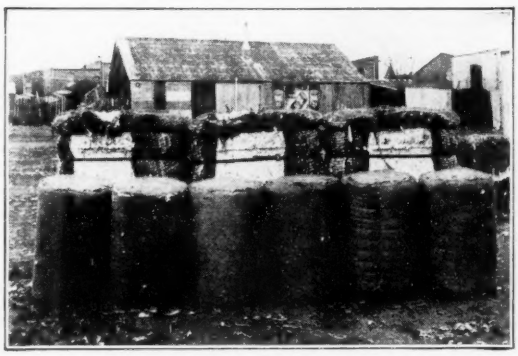
THE ROUNDBALE PRESS

This machine packs cotton into high-density, convenient-sized rolls. The resulting "bale" is completely covered with burlap

THERE are two phases of this great anomoly, one being transportation and the other, the form of the commodity and the way in which it is handled. Under existing methods the farmer brings his seed cotton to the nearest gin, where the lint is baled in what is called the "plantation bale," weighing about 500 pounds and with a density of about 12 pounds to the cubic foot. Thirty three of these are loaded in the average freight car and in 100-bale lots shipped to the nearest compress. There it is unloaded while the cars remain idle and the bales are compressed to a density of 22 pounds to the cubic foot. The hundred bales are then loaded in two cars and shipped to their destination. If they are destined for shipment abroad, then before being loaded on a vessel and in

order further to reduce the size to a density of 32 pounds per cubic foot, they are again subjected to compression in what is called a high-density press. An ocean freight differential makes this last operation profitable. It is not difficult to conceive of the enormous cost of thus frequently handling a bulky commodity weighing a quarter of a ton, in addition to the loss of time in transportation and rolling stock.

The other wanton economic waste is in the form and system of handling the crop under existing conditions. It will no doubt surprise those who boast of our progressive methods to learn that even countries like India and China are far ahead of us in some respects in the handling of a cotton crop.



A STRIKING COMPARISON

Three unwieldy plantation bales compared with six roundbales containing the same amount of cotton

AS is readily seen from our illustrations, the American bale is only partly covered by a coarse jute covering, which affords but little protection and adds greatly to the weight. By reason of the fact that about 90 percent of our crop is gathered in a limited area in four months, and in the absence of adequate warehouse protection, it is a common sight to see hundreds of bales lying out in the mud and exposed to wind and weather until ready for shipment. The result is what is known in the trade as "country damage," and this hazard is regularly provided for in insurance policies.

Since cotton fiber is highly absorbent, it holds much water which cakes and disintegrates the staple until often as much as a third of a bale is ruined. The hazard from fire is greater than it is in a less exposed and more compact bale and the insurance, as well as the marine rate, is correspondingly higher. No doubt sparks generated by the striking of iron ties against one another in the hold of a vessel have been responsible for many fires at sea. Incidentally, since these ties weigh 25 pounds per bale, they constitute an additional expense in transportation as well as in cost. Another source of loss from the present system is that a portion of each cargo reaching a foreign port is designated in the trade as "no marks," that is, bales from which the marks have been blurred so as to render identification impossible and ownership doubtful. These bales are apportioned among the consignees of the shipment regardless of value.

OLD BLACK JOE

A factor in cotton production that cannot be eliminated: hand labor in the fields

To the layman the question arises: "Why has not some of the inventive talent of the United States devised methods to do away with this seemingly preventable loss, by compressing cotton at the gin?" A few years ago a determined effort was made to introduce gin compression of square bales—that is, a bale of the usual shape and weight but compressed at the gin to a density equal to the "high density" compressed bales. These were adequately covered to prevent loss from damage, theft, and also to reduce the fire hazard to some extent. They were a marked improvement over the present system, as pointed out by the Department of Commerce pamphlet: "Packing and Marketing of Cotton." It is believed that none of these presses is now in operation, possibly for the reason that the reform did not go to the full extent necessary to correct all of the abuses of the existing conditions.

More than a generation ago, inventors had succeeded in producing a revolutionary type of bale which, for want of a better name, was called a "roundbale." It was cylindrical in shape and was made by forming the lint cotton into a "bat," or batting. This was run through heavy iron rollers so that the air was gradually expelled. By this method, a density of about 32 pounds to the cubic foot was obtained, a density equal to the best obtainable with hydraulic presses. Passing the staple through the rollers had the advantage of smoothing and straightening the fiber in contrast to the effect of the sudden stroke of the powerful hydraulic press.

THE bale was made by winding the bat like a roll of carpet and since the air had been gradually expressed, there was no need of iron ties. Therefore the bale was completely covered by a closely woven burlap, ready for shipment by rail or steamer direct to its destination. This burlap covering constitutes a tare of 1 percent—or five pounds to 500 pounds of lint (that is, two round bales)—whereas the bale of commerce has 6 percent tare and is sold on that basis—or 30 pounds to 500 pounds of lint. This saving in the cost of the bagging and ties and the freight thereon is enormous.

In brief, the system had so many advantages that in 1897, Mr. John E. Searles, one of the most successful financiers of his day, with a group of associates, organized The American Cotton Company. All of the several roundbale interests were consolidated in this organization, and their first step was to employ the best available engineering talent to perfect a roundbale press by selecting the best features from existing inventions and eliminating some of the me-

ON THE SHIPPING PLATFORM

Bales, bursting of their own pressure despite heavy iron ties, ready to be shipped. Transportation cost on these is very high because so few of these bulky bales can be loaded into an ordinary freight car

THE SUPERIOR ORIENTAL BALE

In India, China, and Egypt, cotton is compressed into more compact bales than in America, and is thoroughly covered. Waste is negligible, freight costs are low, and markings legible

chanical defects such as are incidental to all inventions in their early stages of development.

The result was a package so fundamentally superior in every way to the square bales that within a few years the company was producing over 900,000 roundbales a year. Not only were the spinners here and abroad enthusiastic over its success but fire and marine underwriters and practically every disinterested factor in the cotton industry gave their heartiest support to the movement. One radical change in the roundbale itself was in size and weight. It was originally 48 inches long and weighed about 400 pounds, but the spinners suggested that a bale 35 inches long could be readily unwound by a simple mechanism directly into their mixers.

THIS recommendation resulted in the production of a bale of about 250 pounds which was easier to handle and constituted, for transportation purposes, an ideal package. Since then, all roundbales are of that standard size and weight and are classified in Government statistics as "half bales." It then seemed that the metamorphosis was complete all along the line and, with gin compression an accomplished fact, there would never be another hydraulic compress constructed. "Density compression at the gins would save hundreds of millions a year," said an authority several years ago, "hundreds of millions that now go for rehandling, extra haulage, needless space taken up on steamships and railroads, loss in transit, claims for damage, and for other items."

Then began a titanic struggle for supremacy. With perhaps 100,000,000 dollars invested in compress property, the owners were not altruistic enough to sit idly by and see their property become worthless. At that time the influence of the railroads was, for two reasons, thrown into the fight on the side of the compress interests. Many of the railroads held large blocks of compress stock, and furthermore their chief shippers were cotton firms who owned the compresses. Their chief weapon was the argument that The American Cotton Company was a gigantic trust—this at a time when politicians were making political capital by advocating the free coinage of silver and fighting the "money devil of Wall Street." They convinced those who were being benefited the most that, under the guise of correcting the many abuses in the cotton industry, the real purpose of the proponents of the roundbale was to control and monopolize the cotton crop through ownership of all roundbale patents.

The fight has even been carried to Congress. A few years ago Senator Ransdell of Louisiana introduced the following bill: "That the interstate Commerce Commission shall establish and enforce preferential rates on shipments of cotton based upon the cubic contents of the bale. In reaching its decision the Commission shall take into consideration the density of the bale, the amount of space it occupies, its uniformity in size, the character of its covering as a safeguard against damage or fire, and any other points that seem fairly to entitle it to favorable discrimination." The bill would have had the effect of favoring roundbale compression through preferential rates. This bill was never passed, but with its important bearing on lower freight rates and farm relief, it will, more than likely, receive favorable consideration at some future session.

THUS it was that the compress won the fight and Mr. Searles' organization went into bankruptcy. For a time it seemed to the friends of the South that there was no hope of any further attempts to bring about these much needed reforms. In recent years, however, others have taken up the battle for gin compression, and have met with considerable success. There are now three distinctive types of roundbale compresses in use, one firm operating 260 presses. Although the entire roundbale output is less than 3 percent of the total American crop, the roundbale system is making marked progress each season, purely on its intrinsic merit.

Thus the situation stands. So long as a larger portion of this inexcusable waste is eliminated each year by the extension of a system that has everything to recommend it, the day is not far distant when the blot on the fair escutcheon of the South will have been entirely wiped out.

A SHAMEFUL CONDITION

An example of the inefficient method of baling cotton generally used in the South today. In the staple that has been pulled from the bale may be seen much that is badly soiled

SITE OF THE EXCAVATION

This photograph shows in a striking manner the spot where evidences of early Indians of Florida were found. Many of the skulls and bones so far dug up are displayed here

Early Indians of Florida

A FIND of great interest which is unique in some respects has been made by George Henriquez while digging beside his house near Tampa, Florida.

Up to the end of January, 133 skeletons had been unearthed. The skulls and bones of these show many different types: some have flat heads with no foreheads, the top structure extending back from immediately above the eyes like apes; others are nearly an inch thick, while still others extend up to a peak on top. Several sutureless skulls show that a number of this race lived to advanced age.

The most unusual part of the find, however, is the skulls with short bony protuberances at the base of the skull, probably an exceptional development of the styloid process which developed into a part of the skull bone.

THE teeth and jaws are massive and strong and in all the specimens unearthed there has been found not one decayed tooth. In fact the front teeth resemble our double teeth; some even being turned edge forward. This is undoubtedly accounted for by the fact that they lived on natural coarse food, corn, fruits, berries, roots, et cetera.

The burial method is interesting. Most of those buried in the circles are in a reclining position; some have extremities doubled up to the trunks, others are curled up on their sides, while still others have the heads separated from the bodies, some six or eight heads being buried together and the bones doubled up and laid to one side like a bundle of sticks, this being a later burial than the first, probably a transferal from some other spot after an epidemic or calamity. In each case a conch shell perforated by a large hole is placed over the head at burial. Contiguous beds of charcoal indicate that ceremonial rites of fire were part of the burial ceremony.

Beads and ornaments made of shell, bone, horn, stone, and iron have been found with the remains of the women and children. Also pottery with many curious, unique, and interesting designs and inscriptions, circles with crosses in the center, circles blended together, and spirals. Others have triangular designs, snake designs, check designs and a design showing a man's head with beard, beak nose, and features which suggest a possible Mayan influence.

UNDOUBTEDLY this latest find belongs to the epoch of the other Tampa Bay mounds which, according to the Smithsonian Institution, probably range in age from 300 to 800 years, so no very remote antiquity can be assigned to them. They are the product of the Calusa and Timucua Indians who occupied them at the time Florida was first visited by Europeans, but archeological evidence indicates that some of the sites had accumulated a few centuries earlier.

Fortunately for archeology Mr. J. J. Hall, Secretary of the Florida Archeological Society, to whom we are indebted for the information about this find, is in active touch with the progress of excavation, so that all important features of the development will be preserved. If funds are forthcoming it is proposed to move Mr. Henriquez's house and proceed with the research.

LARGE TEETH, MASSIVE JAWS

In all the specimens located up to the time of writing, not a single decayed tooth was found. Note the broad grinding surfaces of the teeth, especially the front ones

HORNS?

This view shows a bony projection extending one and one half inches from the base of the skull

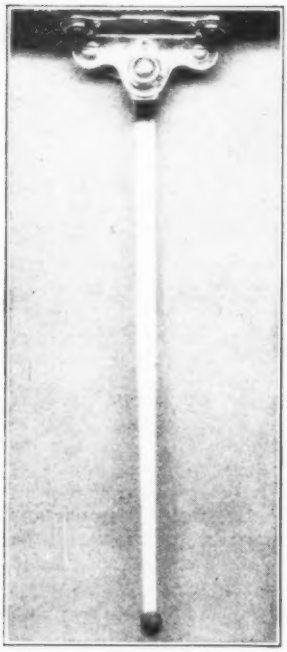
Inventions New and Interesting

TOP REMOVER

Utilizing the advantage of a downward push rather than a pull, this little "top tipper" effectively prys the lids from jelly glasses and similar containers.—*United Power and Manufacturing Company, P. O. Box 598, Chicago, Ill.*

FLOOR POLISHER

Light weight and simplicity of operation characterize this electric floor polisher. It is operated by a powerful ball-bearing equipped, universal motor, using direct or alternating current.—*American Floor Surfacing Machine Co., Toledo, Ohio*



SELF PROPELLED AQUAPLANE

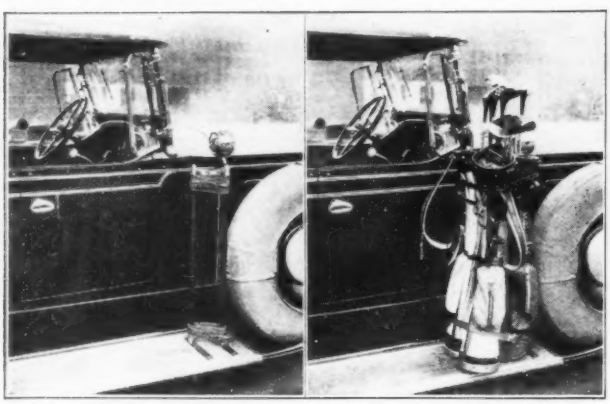
This aquaplane has its own outboard motor, and attains speeds of more than thirty miles per hour. It has a device that turns off the motor if the rider falls off, and will not sink or capsize.—*The Skiboard Corporation, 72 Hubbard Street, Brooklyn, N. Y.*

HEATER AIDS WINDSHIELD CLEANER

This novel instrument generates a gentle heat, which is transmitted through the glass to melt sleet or snow on the outside of the windshield that may impede the operation of the cleaner. When not in use it is to be moved aside.—*Trico Products Corp., Buffalo, N. Y.*

CLOTHES LINE EXTENSION

This folding, pivoted arm brings one end of a clothes line into the house, where garments and other articles can be attached to the line without danger or inconvenience.—*Jamaica Home Appliance Co., Jamaica, N. Y.*



GOLF BAG HOLDER FOR RUNNING BOARD

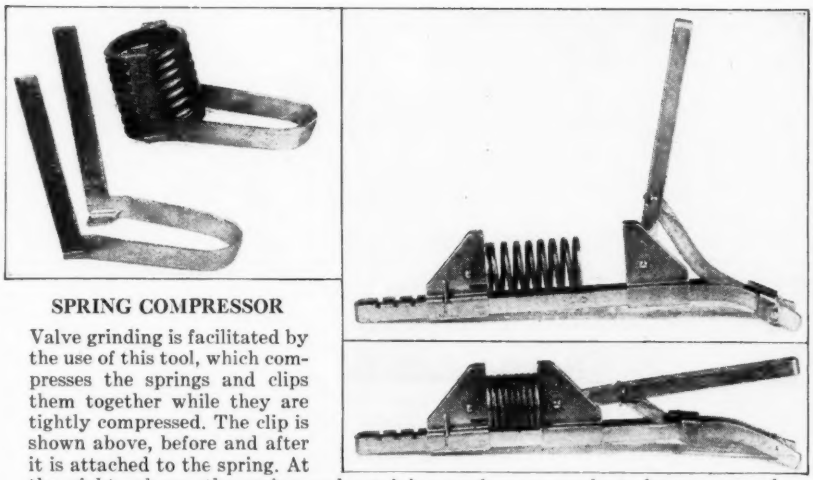
More leg room in the tonneau is provided by using this sturdy golf bag carrier. It is permanently attached to the running board, and accommodates four golf bags or similar articles. Another model can easily be clamped on the running board, and removed when not in use.—*Tonneau Shield Company, 518 West 57th Street, New York, N. Y.*

TOOTHLESS RATCHET WRENCH FOR PIPE

Operating in the closest places, this ratchet wrench makes or breaks the tightest joints without "chewing" or marring the pipe. It has no teeth, and takes a new grip with the slightest movement of the lever-like handle. The girths for gripping the pipe come in several sizes.—*The Walworth Company, Statler Building, Boston, Mass.*

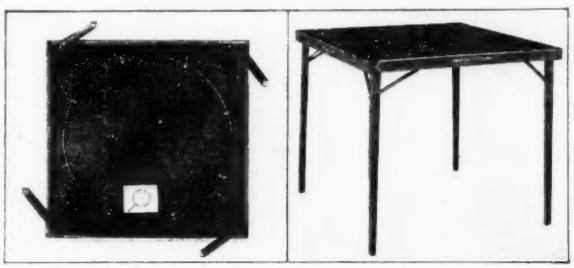
KITCHEN CABINET

In the modern apartment or home, these new steel kitchen cabinets take the place of the old-fashioned pantry and cupboard. The new arrangement saves time, space, and materials. A single turn of a handle releases the desired amount of sugar, flour, or spice without exposing the contents. — *Maxwell Burke, Inc., Builders Building, Chicago, Illinois*



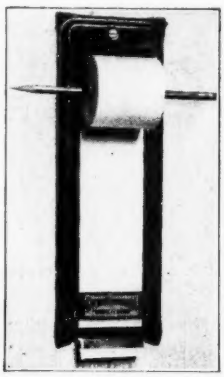
SPRING COMPRESSOR

Valve grinding is facilitated by the use of this tool, which compresses the springs and clips them together while they are tightly compressed. The clip is shown above, before and after it is attached to the spring. At the right, above, the spring and retaining washer are ready to be compressed. While the spring is compressed, the clip is measured, bent, and fastened to the spring. A centering device properly places the clip on the spring. While thus held, the spring is placed in the motor and the clip is jerked off, leaving the spring in place.—*Sunnen Products Company, 6500 Manchester Ave., St. Louis, Mo.*



CARD TABLE FOLDS WITH ONE OPERATION

This folding bridge table can be opened or folded with just one operation. When the patented catch is released, the slightest movement of one leg causes the others to automatically follow suit. When the table is opened for use, the legs are securely locked, providing unusual rigidity and strength. The top of the table is also strengthened by the metal ring that supports the legs.—*Willett Manufacturing Company, Dayton, Ohio*

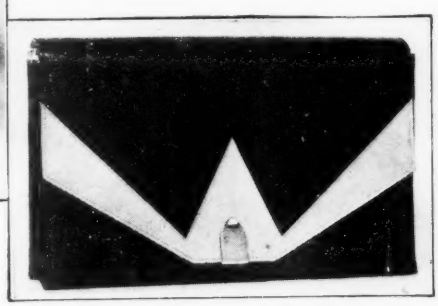


MEMO

When fastened to the wall in the kitchen, this device provides the necessary pencil and paper for jotting down memoranda.—*Burgess Manufacturing Company, Beaver Falls, Pa.*

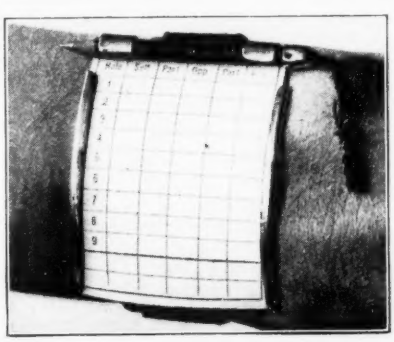
WARDROBE HAND BAG

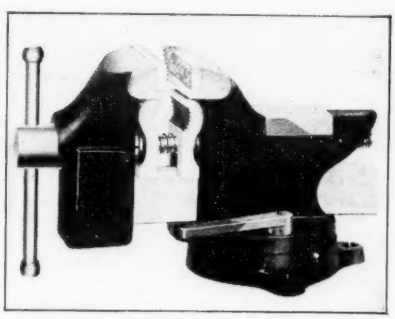
An evening dress, pajamas, handkerchiefs, toilet articles, and whatever else milady may need for an over-night stay, can be carried in this hand bag. A reel provides a means of folding the dress in order that it will not wrinkle while being carried.—*W. W. Winship, 71 Summer Street, Boston, Mass.*



SCORE RECORDER

Fastening on the wrist like a wristwatch, this silver golf score device enables a player to keep an accurate record of his strokes by holes. A pencil is carried as part of the device. A pocket at the back provides a place to carry paper money.—*T. W. Foster Company, P.O. Box 1415, Providence, R. I.*





MIDGET VISE

A small vise with the quality of an expensive machinist's vise is now available, with swivel base, cold rolled steel screw and handle, permanently locked collar to prevent slipping, replaceable hardened tool-steel jaw-faces, removable pipe jaws, and a husky anvil back. The new models are made in three, three and one half, and four inch sizes.—*Columbian Vise Co., Cleveland, Ohio*

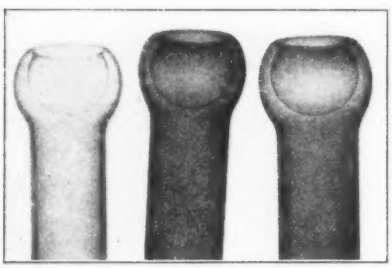
The Scientific American Digest

Newest Developments in Science, Industry, and Engineering

Simplified Lenard Ray Tube Gives Science New Tool

A SIMPLE and easily operated form of the Lenard ray tube has been perfected by Dr. C. M. Slack, of the Research Department of the Westinghouse Lamp Company, Bloomfield, New Jersey, and in order to enable scientists to study the remarkable properties of Lenard rays and to develop practical uses for them, if possible, a number of these new tubes have been presented to chemical, physical, and medical laboratories in various parts of the country.

"The Lenard ray tube can best be described by comparing it to the X-ray tube,"



With walls half the thickness of cigarette paper, these windows of the new Lenard ray tubes had to be photographed by means of the X ray to render them visible

said Dr. Harvey C. Rentschler, Director of Research of the Westinghouse Lamp Company. "In the X-ray tube, cathode rays (which are streams of electrons) are developed electrically and are directed against a metallic target. This target, energized by the cathode rays, gives off X rays. Lenard's invention consisted in removing the target from an X-ray tube and placing a thin metallic 'window' at one end of the tube against which the cathode rays were directed. He found that, when sufficiently high voltages were employed, the cathode rays themselves could be driven through this window, thus making possible their application in innumerable ways; such rays are termed Lenard rays. Since X rays represent a secondary effect of the cathode rays, it is evident that Lenard rays themselves must be immensely more powerful.

"Ever since this kind of tube was devised by Lenard in 1894, scientists have known that it was an instrument of extraordinary powers," states Dr. Rentschler, "but owing to the complication and operating difficulties of such forms as have heretofore been developed, only a small amount of study has so far been made. Dr. Slack, however, has produced a Lenard ray tube that is simpler than the ordinary X-ray tube—perhaps it can be fairly compared to an electric lamp or radio tube—and that can be operated by anyone of scientific training with the aid of apparatus to be found in almost every well equipped laboratory. He has, therefore, made Lenard rays available to general scientific research.

"The chief difficulty with Lenard's tube and later models based on it is the metallic window. The use of this window involves numerous operating complications, including the necessity of employing voltages of over 100,000, liquid air, or a continuously-operating vacuum pump. Dr. Slack's improvement consists in substituting a glass window for the metallic one, which enables us to make tubes having a permanent vacuum, thereby eliminating the need of all extraneous apparatus, except an ordinary X-ray outfit for producing the current for operating the tube.

"Dr. Slack uses a window of less than one two-thousandths of an inch in thickness, which is about half the thickness of ordinary cigarette paper, and this is more transparent to the rays than are the metal foils heretofore used. So thin is this window, that the slightest touch may destroy it, and yet, owing to the form Dr. Slack has employed, it withstands handling and transportation, and does not rupture even though it has to carry full atmospheric pressure due to the vacuum behind it.

"This window is formed by first blowing a bulb at the end of a glass tube of special composition. A section near the end of the bulb is then heated to a very high temperature, and, at the proper moment, the glass blower sucks into the tube, thereby drawing back into the bulb an extremely thin-walled spherical bubble of glass. The bulb, with its external bubble, is then mounted on the end of a larger tube containing electron-producing electrodes, the air is pumped out, and the tube is sealed up. The making of the windows requires the highest degree of skill and experience, but an expert can turn out hundreds of them a day.

"We know little about the properties of Lenard rays except that they are capable of causing remarkable and mysterious physical, chemical, and physiological changes, such as causing minerals to glow, changing gases into solids of unknown constitution, and destroying the life of animal and vegetable cells," said Dr. Rentschler. "X rays, also an unknown quantity at one time, have been of immense benefit to humanity and, since Lenard rays probably possess greater power, they may prove even more useful. Through Dr. Slack's accomplishment, science has been given a new and convenient tool of immense possibilities."

The laboratory worker at the right is pointing to the bubble window of the new Lenard ray tube, for which it is expected that many uses will be found

"Squirting" Cold Copper Into Tubes

THE Winchester Repeating Arms Company of New Haven, Connecticut, is carrying on a unique and very interesting process of metal working at the present time. This process is known as the cold extrusion method of manufacturing seamless copper tubes. The application of these tubes is rapidly becoming familiar to the public through their increasing use in radiators for automobiles and airplanes and in the heat transfer elements of several unit heating systems.

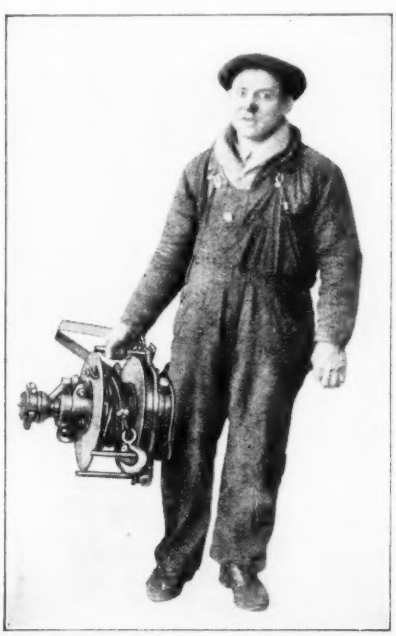
The essential principle of extrusion is exemplified in the manufacture of macaroni—that is, a plastic material is forced under pressure through an annular or ring-shaped mold, making a seamless hollow tube. This same sort of extrusion has been in use in manufacturing lead pipes since 1850, and in a modified form, in making collapsible tube containers for shaving cream and for numerous other toilet preparations.

The newer application of the extrusion principle, however, does not deal with such soft substances as dough, lead, or tin, but with highly purified copper. It is of course known that even copper and other similar non-ferrous metals have been and are continuing to be extruded in various forms, but always in a heated state; that is, the metal to be extruded is heated almost to its melting point, and is then extruded, this high temperature making the metal very plastic and therefore, relatively easy to extrude. The method used in the new process, however, is to extrude copper without any preliminary heating whatsoever.

The high pressure required to make the copper flow through a die as a plastic material offers a mechanical problem, the solution of which has required a great deal

of ingenious experimenting and development. The pressures to which the punches and dies are subjected in the process are nearly equal to the yield point of the steel. For this reason any factors in the operation which could cause a slight increase in the extrusion pressure, result in tool breakage. In a like manner any tool whose strength is slightly below specification due to faulty material, heat treatment, or workmanship will not stand up at all under the terrific punishment. In order to obtain satisfactory tools, a great many steels of different analysis and different methods of heat treatment had to be tried, and at present the quality of the tools must be rigidly maintained.

The procedure is briefly as follows: Copper rods approximately one half inch in diameter and of a purity of at least 99.90 percent are cut up in a shearing machine to form small cylinders seven sixteenths of an inch long. These are pierced along their axes in two successive punching operations forming cylindrical cups with walls one tenth of an inch in thickness and with a bottom of tissue-paper thinness. These cylinders or cups then reach the extrusion press where each cup is in turn enclosed in a hard steel ring and pressed downward by a punch against the die at the bottom. The machine applies a pressure of approximately 50,000 pounds on the copper cup and the only place for the metal to go is downwards through the narrow ring-shaped opening between the punch and the sides of the die. For an instant, the copper resists the pressure applied by the press and then literally squirts through the opening to emerge as a seamless tube about 11 inches long. This process can be better visualized when it is pictured that the extrusion presses have a stroke of about two inches and that the work emerges 11 inches long, all of the extrusion being done in one fifteenth of a second actual time. The wall thickness depends upon the size of the opening and is very accurately controlled. Tubes varying in thickness from .0035 inch to .0010 inch are made in this manner.



The automobile-operated hoist can be carried with ease by one man

Mr. L. S. Keilholtz, chief engineer of the Frigidaire Corporation, with two of the new room coolers, one of which is opened to show its interior mechanism

The immediate importance of this process depends upon the demand for the above types of tubing. Its principle use so far has been in the manufacture of heat interchangers such as radiators for automobiles and airplanes, steam radiators for forced draft unit heaters, and condensers for refrigerating machines and for steam engines. Lately a successful experimental fire-tube hot-water boiler, which looks extremely promising, has been made from these seamless extruded copper tubes.

Refrigerated Air for Homes and Offices

AN ELECTRIC room cooler, designed by Frigidaire Corporation for use in homes and offices, science's latest conquest over the discomforts of nature, has just been announced. In experimental tests, this cooler lowered the temperature of an average size room as much as 10 degrees in 30 minutes and brought about a 10 percent reduction in humidity.

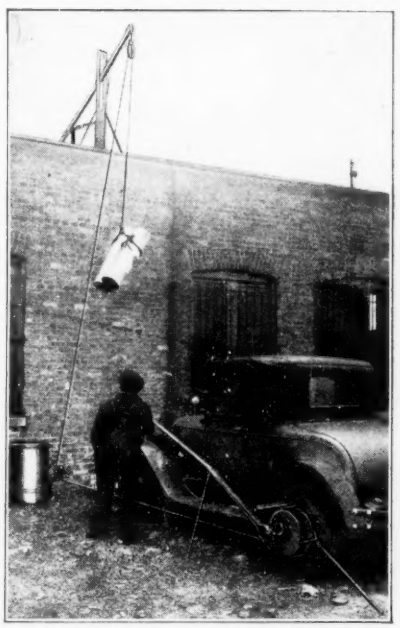
When the cooler is in operation, the air passes into it through louvres in the front panel of the cabinet and through the bottom. This air is passed over cooling coils, and a fan with a capacity of 450 cubic feet a minute distributes the cold air into the room. The fan can be used alone like an ordinary electric fan.

The room cooler stands approximately four feet high and weighs 210 pounds.

Hoist Operated by Automobile

FOR roofers, steamfitters, plumbers, plasterers, building contractors, or anyone who has hoisting to do and runs a truck or car, a new hoist has been announced by the Moore-Master Manufacturing Company of Chicago. This hoist, which weighs about 88 pounds exclusive of the cable, is designed to be attached to the hub of the left rear wheel of any automobile or truck, the vehicle motor supplying the power.

The Master hoist is a cable drum with brake and clutch. It is attached to a ring which has previously been attached permanently to the vehicle hub by means of U-bolts. It may be used on any type of car, and any number of cars may be equipped with attachment rings so that, if one car of a fleet is in use elsewhere, another car may be used for the hoisting.



The hoist, attached to the rear hub of an automobile, is fully controlled by a lever operated by a workman

One lever operates the hoist. With the car motor running and the wheel jacked up, the operator throws in the clutch by a movement of the lever, the load is hoisted, braked at the proper time for emptying, and then is lowered away, empty, by leaving the device in neutral. The clutch and brake are so designed that they cannot be engaged simultaneously.

Hurricanes failed to distort the structure of this arc-welded building in Florida. Note the absence of columns and the lightness of construction

The capacity of this hoist is 600 pounds. The drum will wind 600 feet of one quarter inch cable—enough for a 24-story building. Two hundred feet of cable is enough for a building up to five stories in height.

Hurricanes Fail to Damage Arc-welded Packing House

IN central Florida there have been erected recently 15 buildings of arc-welded steel construction. Most of these are citrus packing houses, scattered throughout the fruit growing districts. The frames of these structures are all of the clear-span welded steel arch type, designed and erected by The Arch Engineering and Construction Company, Orlando, Florida. Portable gas engine driven "Stable-Arc" welders manufactured by the Lincoln Electric Company, Cleveland, Ohio, were used to supply the current necessary for the welding process.

The largest of these buildings—the largest citrus packing house in the world—is owned by the Dr. P. Phillips Company. The building is 117 feet wide by 202 feet long, and due to the welded steel arch design there are no supporting columns in the interior of the structure which contains 200 tons of structural steel.

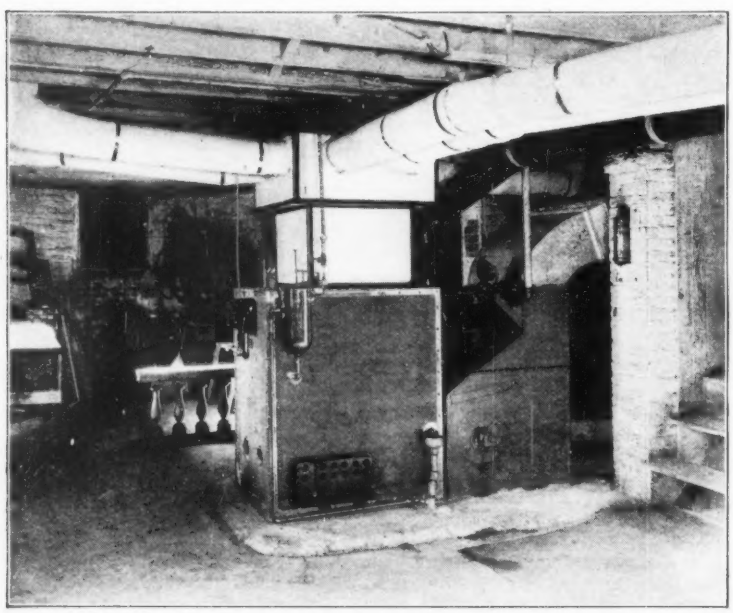
This building was under process of construction when two hurricanes spread disaster in Florida. In the first hurricane the wind blew down the partially completed rear masonry wall, went through the building and blew out the front masonry wall. The arc-welded steel super-structure remained intact, withstanding the terrific strains imposed upon it by the force of the hurricane. Again in the second hurricane, which was more severe than the first, the strength and rigidity of the arc-welded construction was tested severely but the steel framework remained in perfect alignment. Several other buildings of the same design and construction, completed before the hurricanes, survived, although adjacent buildings of other types of steel construction were badly twisted out of shape. With the possible exception of a severe earthquake, no greater test of the strength and rigidity of arc-welded steel construction could be given than was imposed by the Florida hurricanes.

A "Weathermaker" for the Home

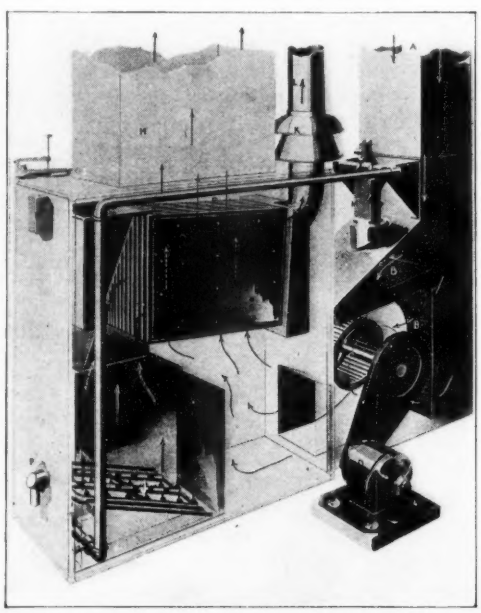
DEFICIENCY of moisture in the average American home during the winter months is so marked that rapid deterioration of woodwork and furniture is largely ascribable to this cause, according to an investigation just completed for some of the large carpet manufacturers. These findings bear out to a large extent the results of research by physicians and scientists in governmental and educational institutions in the east, directed at learning the real reasons for irritation of human mucous membranes in cold weather and the high percentage of illness which occurs during the "confined" months. An interesting answer to the problem which this presents to the average householder has been found in the development by Willis H. Carrier of Newark, New Jersey, of the "Weathermaker," a home air conditioning plant containing many of the principles of the large theater and public installations.

While directed at the effect of deficient humidity on inanimate things, the results of this investigation bear out almost entirely the statement made by Mr. Carrier, more than year ago, that human health and comfort depend on proper conditions of humidity to almost as great a degree as on heat and that much home heating is wasted in a futile effort to make up for deficient humidity. Carrier is the engineer who has designed air conditioning ma-

(*Please turn to page* 559)



A home weathermaker installation. This compact plant takes less space than the usual coal furnace and is entirely automatic



Skeleton view of weathermaker to show the progress of air through the plant

Meeting "high gear" competition, speeding up factory production —with this *grainless* wood

Just the right material for increased production—what a problem it is to find. But in scores of industries where strength is vital and lightness an asset, the answer has been found in the use of Masonite Presdwood. To try out Presdwood is to realize its profitable possibilities. Samples for research gladly sent on request.

TAKES COMMERCIAL PAINT FINISHES

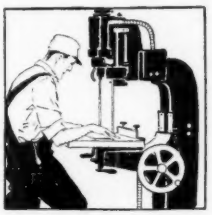
A material that is light, strong, dense, yet easily handled on standard wood working machines — this description but partially tells the manufacturing advantages of Masonite Presdwood. In addition, this sturdy material is naturally beautiful in appearance and capable of taking any commercial finish.

Because Presdwood contains no artificial binder, it does not dull good tools. It is almost impervious to moisture. It does not split or splinter and is highly resistant to warping, buckling, shrinking and swelling.

Still other advantages are uncovered almost daily. Die costs are reduced on punch press operations. Costly rejections in final inspection are no longer encountered. In many, many ways, this grainless wood board is effecting vast savings in modern industry.

For hydroplanes

The lightness of Presdwood has dictated its use for prize winning hydroplanes, both hulls and decks being made of this grainless wood. It is built into toys that are easy for tiny tots to handle. And because of its resistance to moisture, it is ordered in large quantities by makers of outdoor signs. For tops of campers' tables it gives out-of-door convenience without heavily loading the car. In portable billiard tables it provides a perfect surface and keeps down the weight.



EASILY CUT ON THE BAND SAW

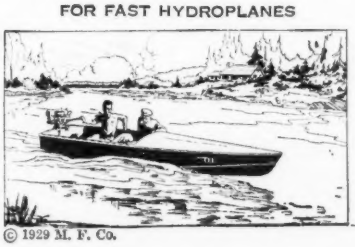
The strength of Presdwood has led to its use in the broad paneled sides of motor truck bodies, on which the buyer's sign can be readily painted. It is used in shipping boxes where merchandise of great value must be adequately protected. It is ideal for show window flooring, office partitions, paneled walls of fine apartments, floors of dance halls and park pavilions, and the decorative ceilings of Pullman-built railroad coaches.

In your business

In your business, too, there is doubtless a place for Presdwood. It comes in four foot boards, twelve feet long. It is also cut to special sizes at the mill. Generous samples gladly furnished. May we send the samples now?

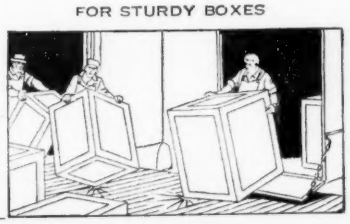
MASONITE CORPORATION
Sales Offices: Dept. 738, 111 W. Washington St.
Chicago, Illinois

FOR FAST HYDROPLANES



Masonite
PRESDWOOD
Made by the makers of
MASONITE STRUCTURAL INSULATION
REG. U.S. PAT. OFF.

FOR STURDY BOXES



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Learning to Use Our Wings

Latest Facts About Airplanes and Airships

CONDUCTED BY ALEXANDER KLEMIN
In charge, Daniel Guggenheim School of Aeronautics, New York City

The Railroads In Aviation

THERE are now five airways that have a service co-ordinated with railroads. More such co-ordinations will follow. The remarks of General W. W. Atterbury, in an interview given to the *Saturday Evening Post* are very significant in this regard.

When the steam carriage first appeared in England the powerful stage coach companies fought it bitterly, and by special legislation drove it off the highways. The steam carriage took to rails and the advent of the automobile was delayed 75 years.

When the executives of the Pennsylvania Railroad realized the advent of air transportation, they had three possible courses that they could adopt: active hostility, indifference similar to that displayed by the railways when the automobile first appeared on the scene, and active co-operation.

Guided by the past history of transportation, they eventually decided on co-operation. They had learned the bitter lesson of loss of traffic and competition from the motor bus.

Each kind of transportation, according to General Atterbury, should be developed in co-operation with the others, with the understanding that each has its own special field in which it particularly excels. This does not mean that railroads should seek control of air-transportation lines. The General thinks that full co-operation can be developed without ownership, and that single ownership might even prove a handicap, because some one branch of the commonly owned services might be neglected.

The great advantage which American aviation has as compared with European aviation is the greater readiness and ability of the American business man to pay extra fares for higher speed and better accomodations. It is apparently no unusual thing for a business man going alone from New York to San Francisco to engage a Pullman drawing room and buy two tickets for the sake of greater privacy and the ability to work on the train.

Considerations such as the above led the Pennsylvania Railroad officials to accept an invitation to a conference in Detroit in 1925, with such men as Henry and Edsel Ford, Howard Coffin, C. M. Keys, and R. E. M. Cowie, President of the American Railway Express. This conference led to the organization of the National Air Transport which is now making air-transport history. After the Lindbergh flight and the enormous growth of American aviation which followed, General Atterbury decided to take action. There followed the formation of the Transcontinental Air Transport, Incorporated, with a capital of 5,000,000 dollars. This united the Pennsylvania Railroad, the Atchison, Topeka and Santa Fé Railroad, and a number of important aviation interests.

General W. W. Atterbury

For the first time the full private story of T. A. T., as it is familiarly called, appears in print.

The 5,000,000 dollars was apportioned as follows; 2,000,000 dollars for operation; 1,000,000 dollars reserve for investigation; and 2,000,000 dollars in a general reserve. The technical committee formed consists of Colonel Lindbergh, Casey Jones, and Major Thomas Lanphier.

The transcontinental route was decided upon after careful investigation. It was considered at the outset that the Alleghany Mountain section was dangerous for flying because of the terrain and unsettled weather conditions. Accordingly the first part of the route will be covered by train from New York to Columbus. There passengers will board a plane that will take them via Indianapolis to St. Louis in time for lunch; then to Kansas City and to Waynoka, Oklahoma, for the end of the day's flying. There they will board a Santa Fé train, and reach Clovis, New Mexico, by morning. The second day's flight will end the journey at Los Angeles. In selecting this route, a lower altitude and more settled weather conditions are expected than on the direct airmail route from Chicago to San Francisco. Over the southwestern deserts there is more clear weather and fewer storms than anywhere in the country.

Airports are being installed at 250 mile intervals, with fields located at some distance from centers of cities, so as to give ample landing and get-away runs. A special railroad station has been appropriated for by the Pennsylvania Railroad, about eight miles out of Columbus, to meet the necessity for joining the railroad and the outlying airport. To secure regularity an independent weather service is being organized, combined with complete telephone communication with the ground.

Accident Analysis

THE N. A. C. A. has done a splendid piece of work in issuing a report on "Methods of Analysis of Aircraft Accidents." The work was done with the co-operation of the Army Air Corps, the Bureau of Aeronautics of the Navy Department, and of the Aeronautics Branch

One of the three-motored Ford planes used by Transcontinental Air Transport, Inc.

N.A.C.A. AIRCRAFT ACCIDENT ANALYSIS FORM

CLASSIFICATION OF ACCIDENT
NATURE: CLASS C TAIL SPIN FOLLOWING ENGINE FAILURE
RESULTS:
PERSONNEL: CLASS B A
MATERIEL: CLASS A

IMMEDIATE CAUSES OF ACCIDENT

UNDERLYING CAUSES OF ACCIDENT:

ERRORS OF PILOT: LACK OF EXPERIENCE (GENERAL, SPECIAL); PHYSICAL AND PSYCHO-LOGICAL (DISEASE OR DEFECT, POOR REACTION)

MATERIEL FAILURES: FAULTY INSTRUCTIONS (OPERATING, MAINTENANCE); INSPECTION (MANUFACTURING, OVERHAUL, MAINTENANCE, INDETERMINATE); MATERIALS (ORIGINALLY DEFECTIVE, DETERIORATED, INDETERMINATE); DESIGN (ORIGINAL: STRENGTH (STRUCTURAL), ARRANGEMENT, AERODYNAMIC, INDETERMINATE; MODIFICATION); INDETERMINATE

%		%		%		TOTAL	RECENT	TOTAL	RECENT	INHERENT	TEMPORARY	INHERENT	TEMPORARY	OPERATING	MAINTENANCE	MANUFACTURING	OVERHAUL	MAINTENANCE	INDETERMINATE	ORIGINALLY DEFECTIVE	DETERIORATED	INDETERMINATE	STRENGTH (STRUCTURAL)	ARRANGEMENT	AERODYNAMIC	INDETERMINATE	MODIFICATION	
75	PERSONNEL	75	ERRORS OF PILOT	35	ERROR OF JUDGMENT								35															
				40	POOR TECHNIQUE								40															
					DISOBEDIENCE OF ORDERS																							
					CARELESSNESS OR NEGLIGENCE																							
					MISCELLANEOUS																							
			ERRORS OF SUPERVISORY PERSONNEL																									
			ERRORS OF OTHER PERSONNEL																									
25	MATERIEL	25	POWER PLANT FAILURE		FUEL SYSTEM																							
					COOLING SYSTEM																							
				25	IGNITION SYSTEM											25												
					LUBRICATION SYSTEM																							
					ENGINE STRUCTURE																							
					PROPELLER AND PROPELLER ACCESSORIES																							
					ENGINE CONTROL SYSTEM																							
					MISCELLANEOUS																							
					UNDETERMINED																							
			STRUCTURAL FAILURE		FLIGHT CONTROL SYSTEM																							
					MOVABLE SURFACES																							
					STABILIZING SURFACES																							
					WINGS, STRUTS, AND BRACINGS																							
					LANDING GEAR																							
					WHEELS, TIRES AND BRAKES																							
					SEAPLANE FLOAT OR BOAT																							
					FUSELAGE, ENGINE MOUNT AND FITTINGS																							
					TAIL SKID OR WHEEL ASSEMBLY																							
					ARRESTING APPLIANCES ON AIRCRAFT																							
					MISCELLANEOUS																							
					UNDETERMINED																							
			HANDLING QUALITIES																									
			INSTRUMENTS																									
			LAUNCHING DEVICES																									
			ARRESTING DEVICES																									
	MISCELLANEOUS		WEATHER																									
			DARKNESS																									
			AIRPORT OR TERRAIN																									
			OTHER																									
	UNDETERMINED AND DOUBTFUL																											

PREPARED AND RECOMMENDED BY SPECIAL COMMITTEE ON THE NOMENCLATURE, SUBDIVISION AND CLASSIFICATION OF AIRCRAFT ACCIDENTS
NATIONAL ADVISORY COMMITTEE FOR AERONAUTICS
JULY 17, 1928

FORM-A

For analysis, aircraft accidents are charted as above. See text below

of the Department of Commerce. Its purpose was the analysis of all accidents in a uniform manner, so that correct conclusions could be more easily arrived at, and so that analyses of accidents caused by various agencies could be more easily compared.

The principal cause of accident as set down by the Committee was error on the part of the pilot. Pilots' errors are believed to be responsible for 50 percent of all accidents. Further, it was found that the tail spin was responsible for the greater part of the accidents. Tail spins must be eliminated by better design of the airplane and by better training of the pilot.

It is interesting to list the causes of accidents as set down in the report. These are:

Collisions in full flight with other aircraft. Such accidents occur more frequently in summer, when the air traffic is heaviest, than in winter. Evidently better traffic rules and closer observation of existing rules is the remedy.

Collisions in full flight with objects other than aircraft. This includes collisions—while at flying speed, and with power plant functioning normally—with trees, poles, houses, mountain sides, or other obstacles. The remedy lies here in so selecting airport and landing-field locations that obstacles are not present in their vicinity. In fog flying, mountain sides may constitute grave dangers. Here the remedy lies in better methods of navigation so that pilots may feel warranted in flying high above fogs and clouds, and not seek to hug the ground so as to keep landmarks in view.

Tail spins following engine failure. These are commonest on making a get-away climb when the engine suddenly fails. Here the remedy lies in the design of aircraft which will not readily stall or fall off on one wing when they do stall. This is largely a problem of applying modern aerodynamic knowledge to the design of aircraft.

Tail spins without engine failure. The remedy here is similar to that of the previous case.

Forced landings. Forced landings may be due to engine trouble and other defects of the airplane, loss of direction, bad weather, darkness, or exhaustion of fuel. More reliable power plants, better maps and navigation methods, and better weather service are here the obvious remedies.

Landing Accidents. If landing accidents occur while making a normal landing, then the pilot is certainly to be blamed. It may safely be said that all good modern airplanes are so designed that they should give a good landing under normal conditions.

Take-off accidents. This includes accidents occuring between the time of starting a take-off and the time when full flying speed is attained. These, in the writer's opinion, should be very rare on good fields.

Taxying. This includes all accidents which occur while the aircraft is maneuvering under its own power on land or water. Granted good fields, taxying accidents occur only in gusty weather, and when the pilot does not correctly take cross winds into account. With good training of our flying men, such accidents, mainly "ground loops" when the plane makes a turn on the ground, should be very rare.

Fires in the Air. The remedy here is more careful installation of existing power plants, and in the development and use of the aircraft Diesel engine burning heavy fuel.

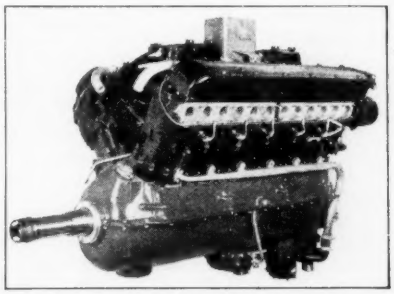
We reproduce herewith the aircraft accident analysis form as finally issued by the Committee. It will be noted that both the Immediate Causes of Accident and the Underlying Causes of Accident are listed. A further advance in accident analysis is made by weighing the causes of accidents. Then each crash can be traced down more closely, and the report of the accident is made more useful to designers and operating personnel alike.

The Conqueror

IN spite of the conviction of air-cooled engine designers that the water-cooled engine is doomed, a good many water-cooled engines are still being built. Among such engines, one of the best is the Curtiss Conqueror.

The Conqueror is a twelve-cylinder engine developing 625 horsepower at 2400 revolutions per minute, and weighing only 755 pounds dry, or about 1.15 pounds per horsepower. The V of the engine includes an angle of 60 degrees, the bore is five and one eighth inches, and the stroke six and one fourth inches. Two high-tension magnetos, and two dual type carburetors, are employed. When geared down two to one, the engine weighs 845 pounds, which is still a very moderate weight. The fuel consumption is .53 pounds per horsepower hour, and the oil consumption .015 pounds per horsepower hour.

It may be asked how designers have reduced the weight of engines of this type. First, by very skilled design. Calculation



Side view of Curtiss Conqueror

and long experience have allowed the dimensions of all parts to be reduced to almost their minimum. Second, by the employment of the very strongest materials, particularly nickel-alloy steels, which are used in crankshaft, connecting rods, oil-pump shafts, propeller hub, et cetera.

As can be seen from the photograph, the engine is very compact and has a small frontal area which is important from the point of aerodynamic resistance. With the air-cooled engine, the new types of

cowling now coming into use shelter the projecting cylinders, but have the disadvantage of impeding the pilot's vision when placed in the nose of the fuselage. When a company such as Curtiss still holds to the policy of offering a large water-cooled engine for commercial plane design, we may draw the conclusion that the water-cooled *versus* air-cooled controversy is not yet closed.

A Seaplane Designer's Views

WE have received a personal communication from Dr. Adolph Rohrbach, German designer of many successful flying boats, which contains several points of interest.

The Rohrbach Company has received an order from the German Lufthansa for three

A Rohrbach Romar in flight

large flying boats of the Rohrbach Romar type, which are to be put into service this summer between Europe and South America.

The Romar is equipped with three 12-cylinder B.M.W. engines of 720 horsepower each. The span of the tapered wing employed is 121 feet, the overall length is 72 feet, the overall height is 28 feet, and the wing area is 1830 square feet. In the design of a cantilever monoplane wing, two objectives have to be attained: one, the greatest possible aerodynamic efficiency, the other the greatest possible strength at the root of the wing. Dr. Rohrbach points out that he has tapered his wing considerably more than has been the practice hitherto, since the width of the tip of the wing is only one fifth of the width at the center of the wing. This evidently gives enormous strength at the foot. At the same time, the huge width at the center protects engines and propellers completely from spray. In flying boat design, hydrodynamic problems are just as important as aerodynamic problems.

In the design of small, conventional airplanes, practice has become so far standardized that it is possible to lay out a machine with comparatively little experimentation. In the design of very large boats, there can be no mistakes allowed. Even a minor error may involve tremendous expenditures during the test-flight stages.

In the design of the Romar, the wind tunnel was freely employed and several hundred wind-tunnel tests were made. We know from personal experience that the best American designers employ wind-tunnel methods to an equal extent.

Seaworthiness of large flying boats is also a fit subject for laboratory experimentation. In the wind tunnel the model is stationary while a stream of air is blown past it. In the water basin, the model is drawn rapidly through the tank, and measurements are made by automatically recording apparatus. The Romar was subjected to 2000 towing runs, covering a distance of 600 miles during such travel.

As a result of this work, the Romar is said to have excellent seaworthiness. Our photographs indicate that the flotation arrangement comprises a comparatively narrow central hull, and two large side floats placed near the main hull instead of two small wing tip floats. This arrangement of floats has not been frequently employed in the United States, but apparently deserves consideration.

The gross weight of the Romar is 42,000 pounds. The loading per square foot is therefore 23 pounds. It is by employing such high loadings per square foot that a useful load of nearly 50 percent and a high speed of 135 miles an hour are obtained, with a range of some 2500 miles. In the average American commercial airplane of to-day, the loading rarely exceeds 10 pounds per square foot of wing area. For seaplanes, 12 pounds per square foot is a good figure. If Rohrbach can get by with 23 pounds per square foot for a flying boat, perhaps higher loadings are indeed legitimate for such craft.

What Is An Air-Scout?

FOR many years we have been familiar with the admirable work of the Boy Scouts. Now the Air Scout has appeared on the scene. The *Aeronautic Review* announces that the Omaha Chapter of the National Aeronautic Association has organized an Air Scout Troop. The boys are being instructed in aviation matters, and by passing suitable tests can secure a One Wing Badge, then the Clipped Wing, then the Full Wing Badge. The tests include such questions as: What is an airfoil?; What is the shape of the propeller blade?; What is the construction of the landing gear?; et cetera.

It will not surprise us if in a few years time each troop of Air Scouts has its own light plane, and boys of 15 years of age or so are sallying forth to the flying field for practice and cross-country flight! The younger generation will certainly be more air-minded, fly more, and learn to fly with greater ease than we do now.

Buying Planes on Installment

IN the last ten years finance companies have helped to increase the sale of automobiles to their present vast proportions. Now the Aviation Credit Corporation proposes to finance the sale of airplanes on similar lines. A private owner will be able to purchase a plane by making a down payment of one third of the price of the plane, and the rest in 12 monthly payments. The purchaser has also to pay a reasonable premium for insurance.

A dealer in airplanes can get still more liberal accomodation, and has only to pay 10 percent of the wholesale price. There are some dangers in the plan. It is doubtful, for example, how much value a repossessed plane will have, and whether it will be possible to sell the repossessed plane with the same certainty as a repossessed automobile. At the same time the plan is likely to be of great assistance to the industry, and we shall watch developments with real interest.

An Aviation Guide

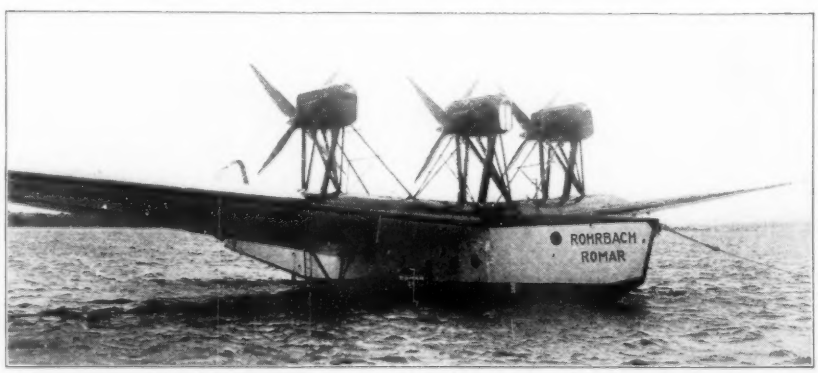
SEVERAL months ago we spoke of the elaborate airway guides published in European countries. Now the *American Official Aviation Guide*, published by John R. Fletcher (Chicago) has made its appearance. Nothing is so reassuring as regards the growth of American air transport as this interesting monthly publication. The index lists 30 airways. Six carry passengers, mail, and express; seven carry passengers and mail; eleven carry passengers only; the rest are engaged solely in mail, or mail and express work.

Five airways have plane-train connections, namely the Northwest Airways; Stout Air Lines; Standard Air Lines; Universal Air Lines; and Pan-American Airways. The American Railway Express Company has contracts with ten airways and lists rates between a great many cities with charges varying from 25 cents to 75 cents per quarter of a pound. In a few years time the aviation guide will be as common-place as a railway guide is now. For the time being it presents real interest.

Let us quote from the announcements of Northwest Airways: "*Fare* between Chicago and St. Paul, 35 dollars, including transportation to and from airports at both terminals. *Equipment*, 16-passenger Ford-Stout tri-motored all-metal cabin monoplanes. Stewards, et cetera. Baggage and toilet facilities. Powered with three 410 horsepower Wasp motors. Maximum speed is 135 miles per hour. Metal propellers, flares, and landing lights. *Rail Connections.* Northwest Airways Service is maintained in co-operation with the Northern Pacific, Great Northern, Chicago, Milwaukee & St. Paul, et cetera.

"Airways schedules are so arranged that planes leaving the twin cities shortly after the arrival in the morning of trains from the Pacific Coast reach Chicago in time to make connections with fast trains for the east, thus effecting a saving of an entire day in a transcontinental trip."

This extract from the guide gives a better idea of the actuality of air transport than the most romantic word picture of a skilled writer in our best magazines.



One of the sturdy flying boats designed by Dr. Adolph Rohrbach

Day and night for more than a year, this group of twelve engines was tested with Ethyl Gasoline. It represents only one phase of the tremendous research program that resulted in the perfecting of Ethyl.

The long search for

A Better Motor Fuel

EVEN among technically minded people, there are very few who realize the infinitely painstaking research which must precede any positive contribution to the improvement of a motor fuel.

Before Ethyl Gasoline was offered to the public, tests like the one illustrated were carried on for more than seven years in the Research Laboratories of General Motors.

Then Ethyl was subjected to ruthless experimentation by the laboratories of the outstanding oil companies of the United States, Canada and the British Isles. Having proved its worth for themselves, they now mix Ethyl fluid—containing tetraethyl lead—with their good gasoline to form Ethyl Gasoline.

The country-wide distribution of Ethyl has encouraged automobile manufacturers to build cars of higher compression. The combination of high compression engines and Ethyl Gasoline has created a new standard of motoring comfort and efficiency.

Whatever your car will do on ordinary gasoline, it will do better on Ethyl.

ETHYL GASOLINE CORPORATION, 25 Broadway, New York City
56 Church Street, Toronto, Canada. 36 Queen Anne's Gate, London, England

ETHYL GASOLINE

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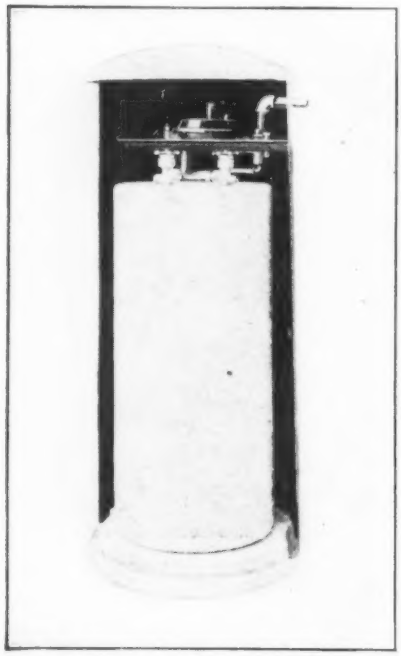
Chemistry in Industry

Advances Made in Industrial and Experimental Chemistry

Natural Gas Byproducts Find New Uses

THE best gasoline motor fuel is that recovered from natural gas—casing head gasoline, a high-test fuel. In its recovery from natural gas, a certain amount of butane and propane is also obtained. These



Container in which liquefied propane gas is delivered for domestic use where gas-mains are lacking

constituents are not desired in the gasoline fraction because of their high volatility, which renders the gasoline "wild." Elimination of these constituents by weathering of natural gasoline was formerly practiced, but this system resulted in a large loss of the desired hydrocarbons, including much pentane and considerable hexane. A variety of methods for the controlled fractionation of wild gasoline were therefore developed, as a result of which the recovery of propane and the butanes was possible, either mixed or, by refractionation, as separate products.

These liquefied petroleum gases have recently assumed substantial industrial importance for a variety of purposes. One of the earliest applications of these liquefied gases was for household fuel use as a substitute for city gas. Such applications are naturally restricted to the areas in suburban and country districts which are beyond the reach of city-gas supply. Under present conditions this would correspond, in actual cost to the customer, approximately to city gas at two dollars per thousand cubic feet, assuming a 530 B. t. u. manufactured gas.

A number of reports have been made on the use of propane and butane as an enricher for blue gas to be used in city-gas supply. A number of industrial uses, for manufacturing chemical compounds, for refrigeration, as solvents, et cetera, have been suggested in addition to the fuel applications. It has been estimated by one of these producers that during 1928 approximately 7,000,000 gallons were manufactured, and it is forecast that this output will be considerably increased during the present year.

White "Blue-Prints"

WHITE "blue-prints" are the invention of German chemists, and the paper is manufactured in that country under the name Ozalid. Copies of tracings reproduced on this paper show black on white and have the additional advantage of being geometrically congruent with the original drawings because the paper is not wet during the developing and hence can not shrink. The developer is ammonia vapor.

A Swedish inventor, N. A. Persson, has recently patented a quick-developing apparatus for Ozalid paper in which the developing is carried out with gaseous ammonia, which is introduced into the closed apparatus from a steel cylinder containing liquid ammonia. An even distribution of the gas over the exposed surface of the paper is obtained by placing a cloth of woolen felt against it. The time required for the developing can be further reduced by moistening very slightly the reverse of the paper, which can be done without any risk of shrinking. The apparatus is provided with a ventilation device and is practically odorless in operation.

Why the Glow-worm "Glimmers"

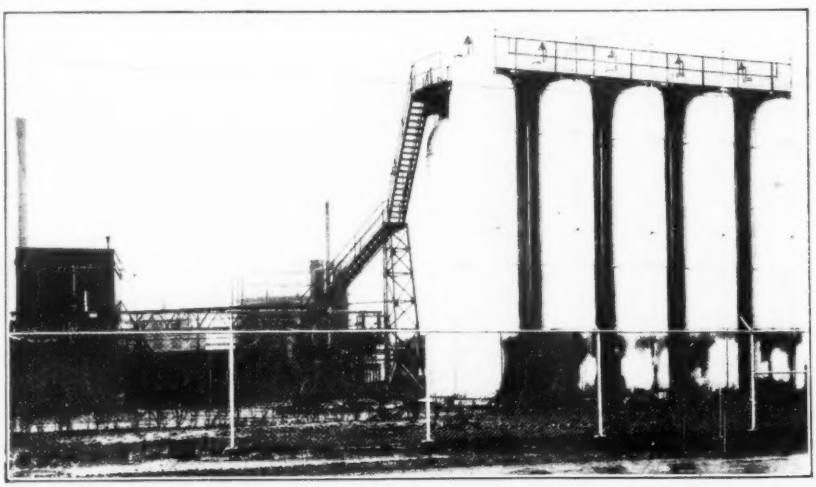
PERHAPS scientists are a step nearer the solution of the mystery that every fire-fly takes as a matter of course—the production of "cold" light. At least, Dr. E. Newton Harvey, professor of physiology at Princeton, appears to have reduced the production of light to a chemical basis. "The question as to whether we shall ever be able to reproduce living light becomes the question of whether we shall ever be able to synthesize the proteins," he says. "Personally, I think that will come in the future. We now synthesize fats, sugar, and some of the polypeptids, which are simple proteins. It is only a matter of time for synthesis of the more complicated compounds of which luciferin is a member.

"Water and oxygen are known to be necessary in the production of this light. It is likely that some material produced by the cells of the animal is oxidized," he said. "This material is called luciferin. Not only one material but two materials are found in addition to water and oxygen. Luminous extract of an animal can be separated into two parts, one containing luciferin, which will oxidize with the production of light and the other part containing a catalyst or enzime, which accelerates the oxidation of luciferin. Chemically, luciferin is probably to be placed among the simplest members of the proteins, the peptones or protesses."

Lighter Concrete Made With Sintered Aggregate

METHODS for the production of lightweight aggregates for concrete have been the subject of numerous patents since 1867, the Department of Commerce points out. It is, however, only recently that the industrial importance of such materials has been fully appreciated. Low-grade clays, shales, and shale rock when heated rapidly at about 2000 degrees, Fahrenheit, for a short period of time expand to two and one half to three times their original volume. Material sintered in this fashion when subsequently crushed and used as concrete aggregate yields concrete of the same or somewhat larger compressive strength and of only two thirds the weight of concrete made with ordinary rock and sand aggregate. The decrease in dead weight resulting from the use of these materials effects a considerable saving in the cost of structural steel for large buildings, bridges, et cetera.

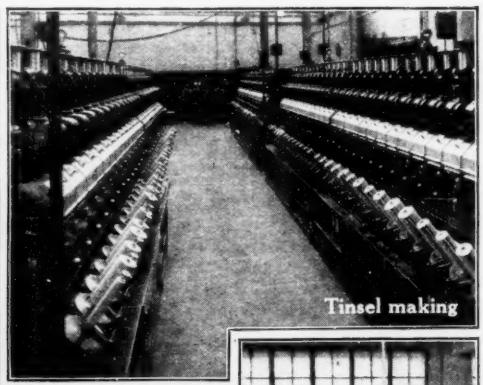
In view of the importance of this new

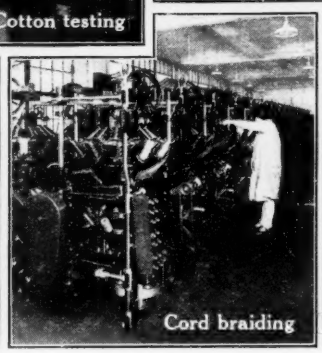


Liquefied petroleum gases, derived as byproducts during the extraction of gasoline from natural gas, are being used to enrich ordinary manufactured gas. The gas holders shown in the illustration are for peak-load demands

Only a telephone cord..

... but see what's behind it!





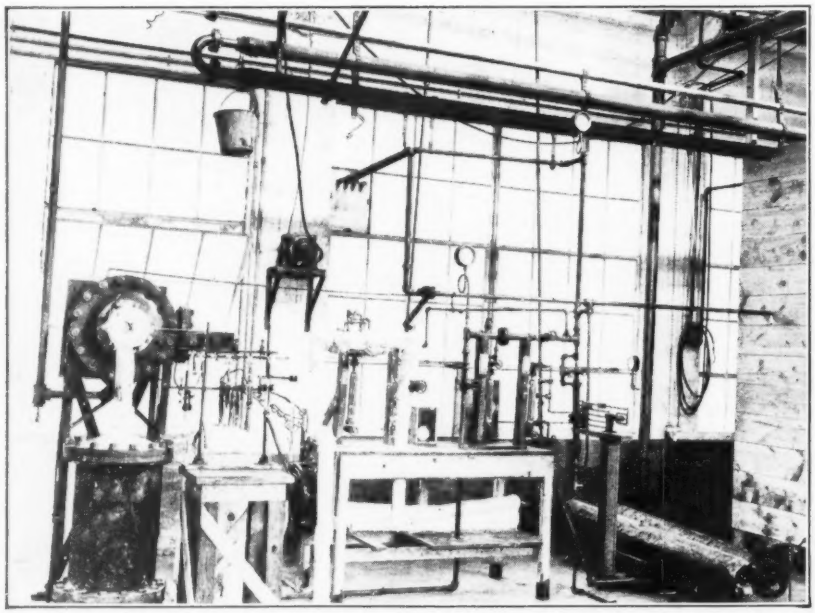
JUST a few feet of insulated wire leading from your telephone to the bell-box—but back of it is a long story of careful workmanship and alert inspection.

Cotton was grown and silk was spun to make that insulation. Wire was drawn into the finest tinsel, covered with the dyed threads, and twisted and braided. It was all done right, because the cord must be rugged enough to take a good many pinchings by desk drawers and still keep on playing its part in a telephone conversation.

This cord is a little thing. But it is just as important to good telephone service as is a fifty-position switchboard or a thousand mile cable. And Western Electric makes it with the same care.

Western Electric

MAKERS OF YOUR TELEPHONE



An experimental unit for the synthesis of nitric acid from ammonia, at the Experimental Station of the Hercules Powder Company at Kenvil, New Jersey

industry as evidenced by the number of inquiries concerning the deposits of clays and shale available for the manufacture of light-weight concrete aggregate, the Non-Metallic Minerals Experiment Station of the United States Bureau of Mines, in co-operation with the Ceramics Department of Rutgers University at New Brunswick, New Jersey, is planning to start a survey of such deposits, and a laboratory investigation of the fundamental factors involved in the manufacture of these aggregates.

Modern Research "Lab" Studies Explosives

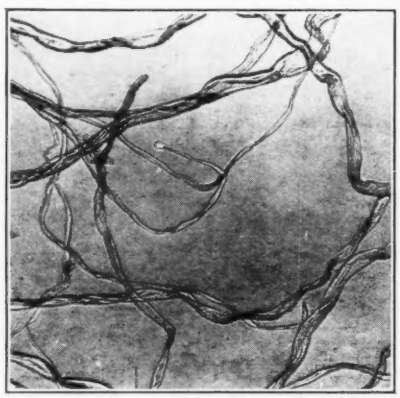
"You better not fool with a bumble bee.
If you don't think they'll sting, you'll see!"

Somehow, that couplet from James Whitcomb Riley's "Child Rhymes" always comes to mind when we visit an explosives plant and see the employees nonchalantly peering over the edge of a nitrator containing enough nitroglycerine to eradicate a whole city. Yet, even as the "Raggedy Man" knew how to handle the bumble bee, so do the hardy denizens of explosives plants go about their jobs with a wholesome appreciation of the danger but still calm in the knowledge that they know their business.

Knowing the explosives business, however, is a mansized job, and it was the ambition to seek out all the kinks and quirks of their numerous products that led the Hercules Powder Company to establish an Experimental Station at Kenvil, New Jersey. Started in 1918 with 20 persons on the staff, the number has grown to 160, of whom 80 are technical college graduates. The personnel of the station is divided into ten main divisions, designated as follows: explosives, smokeless powder, ballistic testing, nitrocellulose, naval stores, physical chemistry, analytical laboratory, library, maintenance, and office.

Chlorine in Condenser Cooling Water Pays Dividends

AN interesting development in the power world is the continuous sterilization of the cooling water for engines and turbines

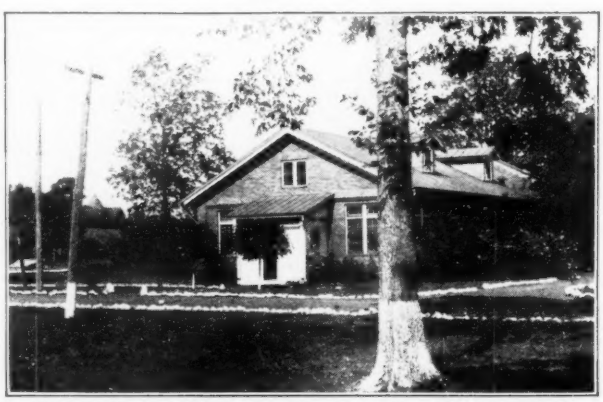


Above—Cellulose fibers, highly magnified, before nitration. *Left*—the fibers changed to gun-cotton

by the addition of a measured trace of chlorine gas, generally about one part per two million, which prevents the formation of organic growths on the inside of condenser tubes and keeps the rate of heat transmission at a maximum. On these lines the highest vacuum is maintained, and a serious drop in efficiency prevented, while the troublesome and costly hand-cleaning of the condenser tubes is eliminated. The method is also being used for the prevention of the growth of slimy deposits in cooling water towers, and for eliminating the growth of mussels and other shell fish in pipes when brackish water or sea-water is employed.

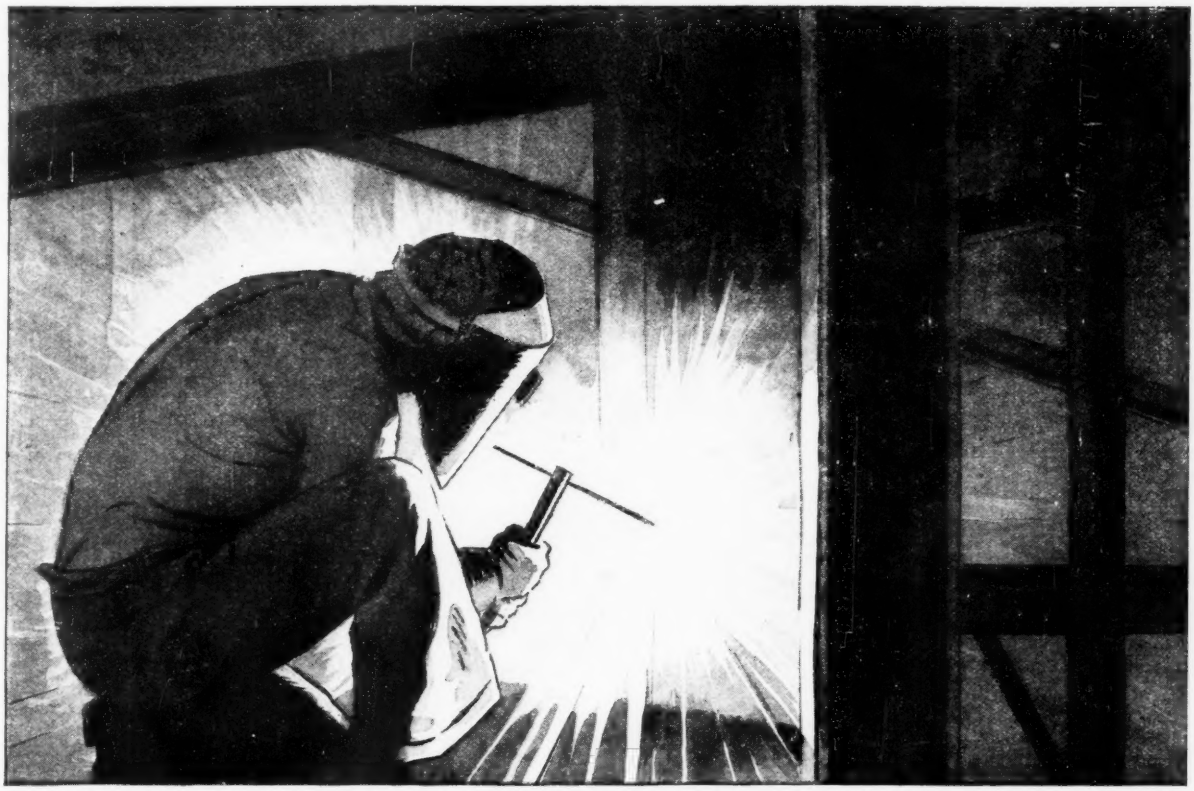
As typical of the results being obtained, the apparatus used in one power station handles an average amount of 72,000,000 gallons of cooling water per day, and from careful records it has been shown that the saving in coal consumption is 8000 dollars a year because of the increased efficiency of the turbines, while in the same period the net reduction in operating costs amounts to 4500 dollars.

One of the laboratory buildings at the Experimental Station, devoted to tests with nitrocellulose products



The Ballastic House at the Hercules Experimental Station, where all of the research work is directed

WHAT WESTINGHOUSE IS DOING IN RESEARCH



WESTINGHOUSE ARC-WELDING NOW MAKES IT POSSIBLE TO ERECT STRUCTURAL STEEL WITHOUT RIVETING

Meet the silent steel-worker

He carries no nerve-wracking hammer, uses no rivets. With a rod in hand, and trailing a bit of wire, the silent steel-worker *welds* steel beams—electrically, quietly, securely.

Only a tiny sputtering arc marks his activity. But under its glow is a concentration of heat that fuses cold steel instantly. Joints knit together with a bond of steel itself. The skeleton of a building becomes in fact a single piece of metal, faithfully fashioned after the architect's plan.

Owner, builder and neighbor alike have been enthusiastic in their approval of the silent method of erecting steel-work. An arc-welded structure equals or exceeds the strength of the same structure designed for riveting; yet twelve per cent less steel is used. Work progresses more rapidly; for much preliminary punching, fabricating and detailing can be eliminated.

Westinghouse was first to apply its arc-welding equipment to large building operations and thus ushered in the silent steel-worker. Westinghouse delves into every possible application of electricity—to give industry better tools, to bring new conveniences to the home.

The Sign of a Westinghouse Dealer

Westinghouse Electrification
Appliances Apparatus
Wiring

Westinghouse

The apparatus consists of an arrangement of reducing and control valves with a metering mechanism affixed to a panel which is connected to cylinders of chlorine; a sulfuric acid seal is included in the circuit, so that the chlorine gas inside the apparatus is kept dry, which prevents any corrosive action. The chlorine gas is first dissolved in a small portion of the water, and by-passed through an absorption apparatus, a very dilute solution of chlorine being discharged to the bulk volume so as to insure absolutely uniform chlorination.

Novel Device Tests Explosibility of Vapors

A PORTABLE instrument that detects immediately the presence of a wide range of combustible gases or vapors, and indicates whether or not the atmosphere containing these gases is safe, has just made its appearance. This device was first developed by the engineers of the Union Car-

bide and Carbon Research Laboratories for the detection of methane or firedamp in coal mines. The indicator utilises the effect of combustion of inflammable gas and air mixtures on the surface of a heated filament. This combuston increases the temperature, and consequently the electrical resistance, of the filament. This change in resistance causes the needle of a meter to move over a scale from which the desired information relative to gas conditions is obtained.

For the operator who desires to know the percentage of a known combustible gas present in a mixture of that gas and air, the meter scale reading is taken and then referred to the particular curve or chart relating to that gas. From the curve chart the operator reads directly the percentage of gas present corresponding to the scale reading of the meter. If an unknown mixture of gases exists, and the operator desires to know whether or not the mixture is explosive, the meter scale reading is taken and referred to a "Percent of Explosibility" curve.

Left and Above: **Front and rear view of indicator for testing the explosibility of combustible gases and vapors in mines and oil tanks**

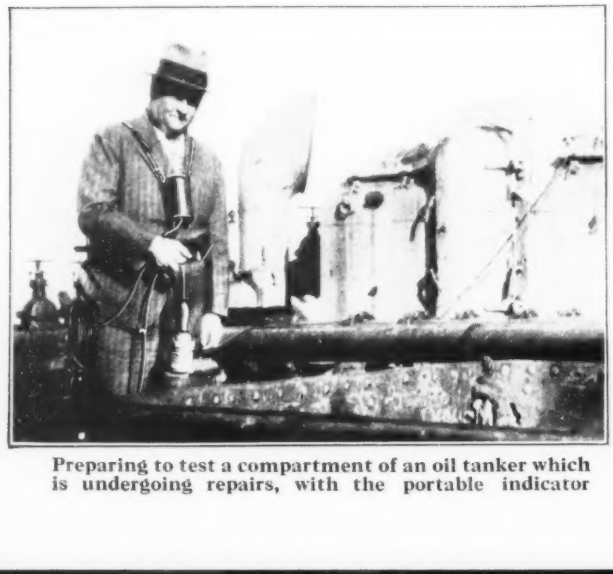
Especially for those concerned with gas testing in and about oil tankers, oil and gasoline storage tanks, tank cars, oil refineries, and the like, the scale is also divided into a white section and a red section. If the meter needle comes to rest anywhere in the red section an atmosphere containing 0.2 percent or more of combustible gas (expressed as pentane vapor) is indicated, showing that the atmosphere is unsafe to breathe without gas masks and unsafe for any work that requires heat, or fire, or is likely to emit sparks.

Using the portable indicator for a test to determine the explosability of vapors in an underground tank

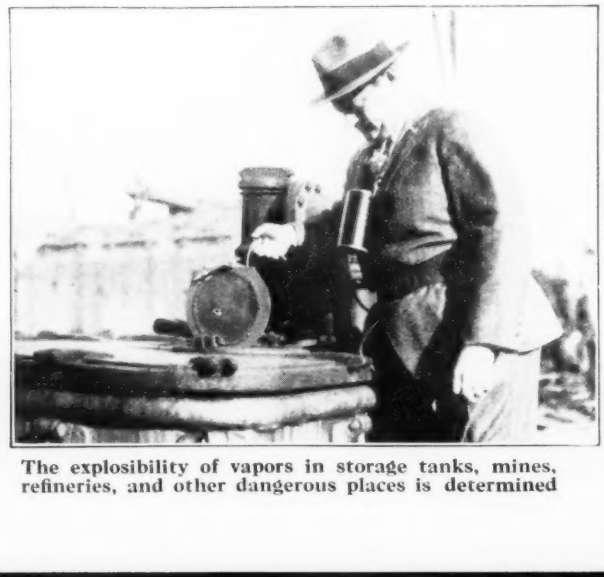
The indicator has been found to operate satisfactorily and safely in explosive mixtures of the following gases and vapors: Methane, ethane, propane, butane, pentane, hexane, gasoline, ethylene, propylene, benzene (benzol), acetone, totuol, ethyl ether, methyl alcohol, ethyl alcohol, propyl alcohol, butyl alcohol, amyl alcohol, hydrogen sulfide and carbon bisulfide.

Preserving Foods by Freezing

PRESERVATION by freezing—one of the oldest methods known to man—is not entirely satisfactory when applied to fresh fruits and vegetables, according to E. F. Kohman, of the research laboratories of the National Canners' Association, who points out that the tissue-destroying



Preparing to test a compartment of an oil tanker which is undergoing repairs, with the portable indicator



The explosibility of vapors in storage tanks, mines, refineries, and other dangerous places is determined

enzymes of the fruits and vegetables are not destroyed but merely inhibited, and that they will resume activity immediately upon thawing. When frozen in the raw state, the freezing process disrupts vegetable tissues to the extent that upon thawing they are soft and not in good condition. Precooling, however, leaves vegetables in a condition where they may be frozen without such injury.

The addition of sugar to fruits before freezing assists in the preservation by extracting moisture and approaches the conditions obtaining in dehydration. Theoretically, corn sugar and levulose (fruit sugar) are twice as effective in this respect as cane sugar, owing to the smaller sizes of their molecules.

Light-Sensitive Resins Used in Decorating Metals

HOW the ingenuity of a chemist in a watch factory led to a discovery of a process which has proved a boon to the lithographer is told by M. C. Beebe in a recent issue of *Chemical and Metallurgical Engineering*. "My interest in the possibilities of finding new light-sensitive bodies," says Mr. Beebe, "developed when I sensed the need for new methods of decorating cases at the Wadsworth Watch Case Company, of Dayton, Kentucky.

"The idea of etching watch cases was old, but it had never been successfully developed on a commercial basis. The light-sensitive substances known in the photo-engraving art were chiefly asphaltum and glue or albumen, the latter two sensitized by dichromate.

"Some oil varnishes were known to be good etching resists, and it was logical to attempt to sensitize them so that they might be adaptable to the photographic method. It seemed reasonable to suppose that synthetic resins might be used as light-sensitive media, especially as many of these condensation reactions are exothermic. The fact that furfural aldehyde was known to change its color when exposed to light confirmed the conviction that we might find in some such resin a good lead to follow.

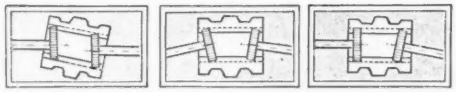
"On the whole the furfural resins seemed to give the most promise, since they printed faster than the other classes of synthetic resins investigated. With suitable dyes incorporated in their solutions, the resinous materials are best adapted to the making of glass positives used in the lithographic trades, to the coating of metal lithographic printing plates to form a tougher image, and for coating copper or zinc plates for photo-engraving. Keeping qualities of the solution are excellent, and coated plates may be kept for considerable periods of time ready for use; also local development may be done in successive steps as its results are proved, until satisfactory."

Oil Burners Create New Demand For Copper

APPROXIMATELY five million pounds of copper are consumed annually in the manufacture of oil-burning installations, according to a survey by the Copper and Brass Research Association. The survey discloses a striking recent exploitation of the field for household oil-heating apparatus. In 1919 the first approved oil heater for homes was listed. Five years later there were less than a dozen approved

(*Please turn to page* 564)

"We can't shut down Number Six! Get it running!"



Two spur gears, one on each shaft end, are completely and continuously meshed in oil with the internal gears of a floating sleeve. The shafts and sleeve revolve noiselessly as one unit, allowing free angular and lateral movement.

ANY MAN who puts old-type flexible couplings in a plant is flirting with disaster.

Shut-downs cost money. One machine often stops a whole plant operation.

But as long as machines are connected by couplings made with flexible pins, bushings, springs, discs or grids that fatigue and fail—shut-downs for repairs are bound to get you!

Banish Shut-downs

It is all so unnecessary. Thousands of plants have banished shut-downs forever by equipping direct-connected machines with Fast's Self-Aligning Couplings.

From huge rolling mill drives down to one-inch shaft pumps, fans and other machinery, Fast's coupling absolutely eliminates all chance of failure—because it has no flexible members to fatigue or fail, nothing to wear out, nothing to be replaced.

Start to Stop—Now!

Stop future shut-downs for coupling repairs by seeing to it that all new machinery is equipped with Fast's Couplings. Start now by replacing (before it breaks down again) the most troublesome drive in your plant—and prove what Fast's Mechanical Flexibility means.

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Current Bulletin Briefs

Short Reviews of Bulletins and Papers on Scientific and Allied Subjects, and Where to Get Them

Aviation

AIRCRAFT PROPELLERS, by Lieutenant Commander C. H. Havill, is a rather technical explanation of the procedure to be followed in selecting propellers of the detached blade type for use on various types of motors. This paper was awarded the Wright Brothers' Medal as the best treatise on aerodynamics, structural theory, or design, presented before the Society during 1928. *Society of Automotive Engineers, 29 West 39th Street, New York, N. Y.—Gratis.*

REPORT OF THE AIRWAY MARKING COMMITTEE, of the Aeronautics Branch of the Department of Commerce, presents the requirements for airway marking, with recommendations for a standard system to be used throughout the country. *Aeronautics Branch, Department of Commerce, Washington, D. C.—Gratis.*

HOW BUSINESS USES AIR TRANSPORTATION reveals that 96 percent of all banks, insurance companies, and business concerns located on airmail and air-transport routes make use of these services. The paper gives the result of a questionnaire sent to representative buiness firms to ascertain the status of airmail in commercial practice, and includes a summary of airmail time tables with a skeleton map of the United States showing the routes now in use. *U. S. Chamber of Commerce, Washington, D. C.—Gratis.*

Agriculture

APPLES, Bulletin Number 34, presents data regarding commodity prices in their relation to transportation costs. The bulletin shows various price phases incident to marketing apples, from producer to consumer, with freight rates from principal producing areas to representative markets. *Bureau of Railway Economics, Transportation Building, Washington, D. C.—Gratis.*

THE ANGORA GOAT AND MOHAIR INDUSTRY Miscellaneous Circular No. 50 of the Department of Agriculture, explains the improvement of the goats and their fleeces as a result of the expansion of the mohair industry in this country. *U. S. Government Printing office, Washington, D. C.—30 cents.*

Construction

TAKING THE MYSTERY OUT OF LUMBER BUYING explains in understandable language the meaning of American Lumber Standards, and simplifies lumber-buying for people who have no technical knowledge of lumber grades. This booklet introduces to the public the new practice of grade-marking the end of each board with a stamp showing the quality of the product. *National Lumber Manufacturers Association, Transportation Building, Washington, D. C.—Gratis.*

PRESERVATIVE CHEMICAL TREATMENT FOR MINE TIMBERING, by Dr. A. M. Howald, explains the technique of wood preservation with special reference to railroad ties and mine timbering. *Mellon Institute for Industrial Research, Pittsburgh, Pa.—Gratis.*

MINIMUM REQUIREMENTS FOR PLUMBING is the title of a report of the Plumbing Committee, of the Department of Commerce, regarding plumbing problems of "sky-scraper" construction. This analysis of plumbing in high buildings is supplementary to a study made several years ago in connection with installations in dwellings and small buildings. *U. S. Government Printing Office, Washington, D. C.—35 cents.*

Electricity

ELECTRIFICATION is the title of an attractive booklet describing the electrification of the New York Central Railway lines. The booklet includes several pages of engineering data, and numerous photographs of exteriors and interiors of plants and equipment, with six wiring diagrams. *General Electric Company, Schenectady, New York.—Gratis.*

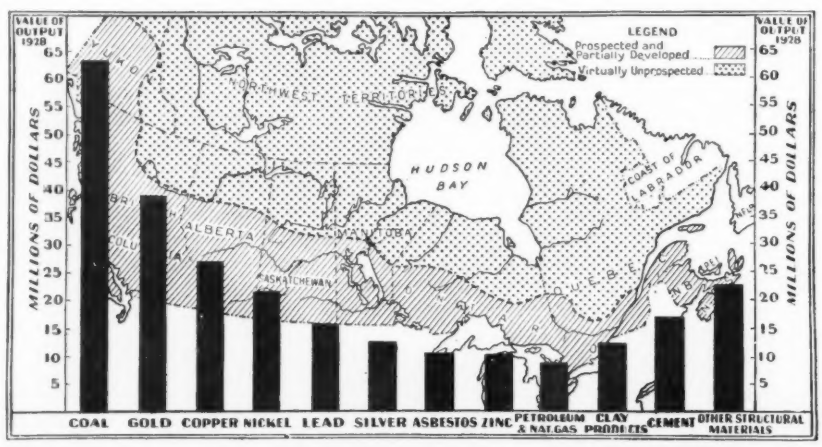
THE POWER MONOPOLY, ITS MAKEUP AND MENACE, by Gifford Pinchot, shows an array of facts of considerable interest, whether or not one agrees with the deductions of the author. The tabulations show that six banking and investment groups, through 35 holding companies, control about 64 percent of the country's electrical power and serve about 68 percent of the population. However, approximately the same situation prevails in the steel industry, where six producers control more than two thirds of the output. Those who want to know where a company is located, or the profits of a certain holding company, or similar facts, will find the book a convenient reference. *Gifford Pinchot, Milford, Pa.—Price not announced.*

STUDY OF ELECTRIC LIGHT AND POWER SERVICE, by Samuel S. Wyer, presents information relating to present-day power service for acquainting the public, through the schools and other agencies, with the fundamental problems of fuel and power. The paper shows the various phases of production, transmission, and use of electricity, and is intended to clarify the disputed question of electric power. *Fuel-Power-Transportation Educational Foundation, 1116 Beggs Building, Columbus, Ohio.—Gratis.*

Geology

MODERN METHODS OF MEASURING THE INTENSITY OF GRAVITY, Special Publication Number 69 of the U. S. Coast and Geodetic Survey, gives detailed instructions for all of the operations required in the measurement and computation of the intensity of gravity. Oil geologists and others engaged in the study of geophysical problems will find this publication of value and interest. Attention is also called to Special Publication Number 23, which is issued gratis, describing the various activities of the Coast and Geodetic Survey. *U. S. Government Printing Office, Washington, D. C.—15 cents.*

THE SCOPE OF CANADA'S MINERAL FIELD, shows the steady ascent of Canada's mineral production in late years, the importance of the Dominion as a field for mineral industry, and the remarkable variety of



Although large areas in the Dominion of Canada are virtually unprospected, the immense value and variety of her mineral resources indicate that Canada's mining industry is assured a stable and well sustained era of development

minerals that enter into the annual output. *Bureau of Statistics, Department of the Interior, Ottawa, Canada.—Gratis.*

Metallurgy

CHROMIUM PLATING PROGRESS, by W. M. Phillips and M. F. Macaulay, includes a short summary of the advancement made during the last 10 years in the methods of plating with copper and nickel, and a discussion of the development and advancement of chromium plating. *Society of Automotive Engineers, 29 West 39th Street, New York, N. Y.—Gratis.*

CADALYTE, A PROCESS AND PRODUCT FOR CADMIUM PLATING, is a descriptive booklet dealing with the development and application of cadmium in the production and fabrication of iron and steel. The properties of the metal, and its advantages as a rust-protective agent, are effectively presented. *The Grasselli Chemical Company, Inc., Columbus, Ohio.—Gratis.*

ROASTING OF LEAD-CARBONATE ORES PRELIMINARY TO GRAVITY CONCENTRATION includes a detailed explanation of the new method of roasting low-grade lead-carbonate ores that have been formerly considered without commercial value. *U. S. Government Printing Office, Washington, D. C.—10 cents.*

Miscellaneous

ABSTRACTS OF SCIENTIFIC AND TECHNICAL PUBLICATIONS from the Massachusetts Institute of Technology indexes important articles and books on a wide variety of scientific subjects. Each item is briefly but capably reviewed. *The Technology Press, Cambridge, Massachusetts.—Gratis.*

A COMPARATIVE STUDY OF WORLD WAR CASUALTIES FROM GAS AND OTHER WEAPONS presents the case for instruments of chemical warfare, in an attempt to dispel the common prejudice against poison gases. Quotations from "The German War Book" are cited in substantiation for the contention that the most dangerous and most massive means of destruction are really the most humane. The booklet is a valuable treatise on the subject of chemical warfare, especially concerning poison gases. *U. S. Government Printing Office, Washington, D. C.—35 cents.*

A SHORT METHOD OF CALCULATING NUTRIENTS IN THE DIET, Technical Bulletin No. 105 of the United States Department of Agriculture, includes a review of early food investigations, food surveys of American families, usual methods of calculating energy and nutrients of the diet and improved short methods of value. A good bibliography on the subject is included. *U. S. Government Printing Office, Washington, D. C.—Five cents.*

ANTHRACITE SIZES FOR DOMESTIC USE, by R. H. Fernald, presents the results of an extensive research to determine the relative economic values of various types of fuel in house heating equipment and in cooking ranges. *Towne Scientific School, University of Pennsylvania, Philadelphia, Pa.—Gratis.*

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1. Every used car is conspicuously marked with its lowest price in plain figures, and that price, just as the price of our new cars, is rigidly maintained.
2. All Studebaker automobiles which are sold as CERTIFIED CARS have been properly reconditioned, and carry a 30-day guarantee for replacement of defective parts and free service on adjustments.
3. Every purchaser of a used car may drive it for five days, and then, if not satisfied for any reason, turn it back and apply the money paid as a credit on the purchase of any other car in stock—new or used. (It is assumed that the car has not been damaged in the meantime.)

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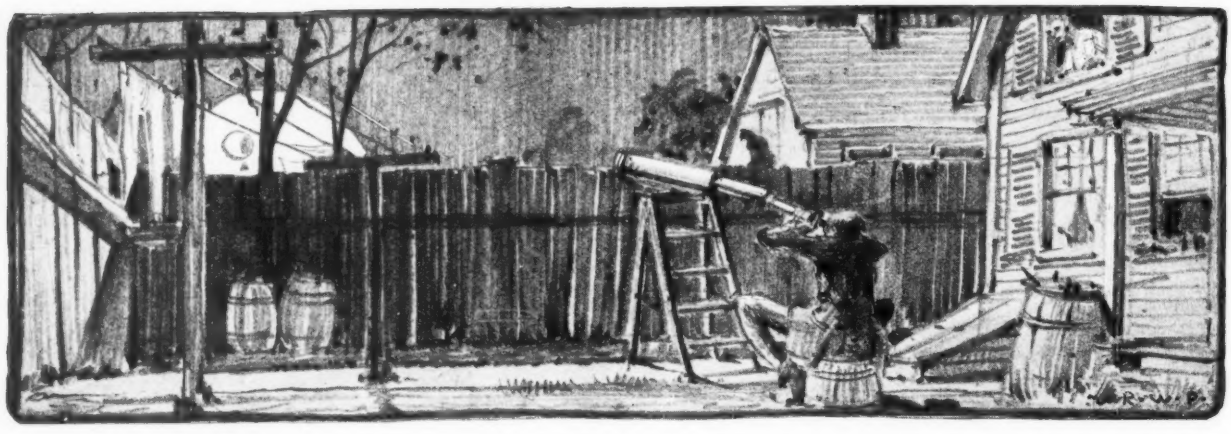
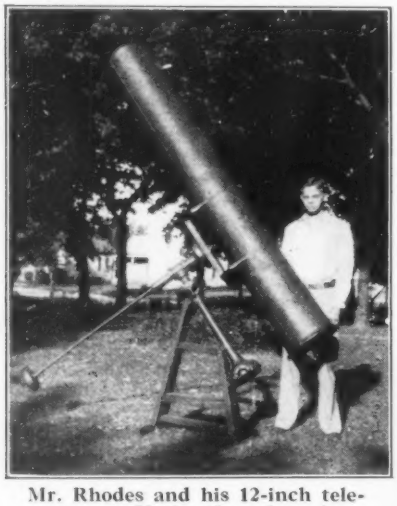


The Amateur Astronomer

MR. THOMAS RHODES, 1721 Eighth Avenue, South, Fort Dodge, Iowa, sends us the following communication—

"It has been two years since my curiosity was sufficiently aroused to send for your instruction book 'Amateur Telescope Making.' Since that day much of the time that I could spare from attending high school has been spent upon the fascinating business of grinding and polishing mirrors.



Mr. Rhodes and his 12-inch telescope. Notice the polar axis

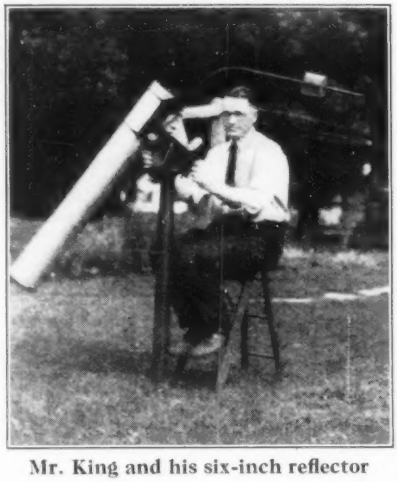
"My first attempt was a mirror of six-inch aperture and 50-inch focal length. The greatest difficulty encountered was the inability to construct a perfect pitch lap. However, the mirror was parabolized in due time, and mounted. The results were very satisfactory, as the telescope gave beautiful definition of all celestial objects which I was able to pick up.

"After finishing my first mirror I decided to construct a larger instrument which would have an equatorial mounting provided with setting circles. This mirror is 12 inches in aperture and 96 inches in focal length. It is a considerably larger job than the earlier one, but the results are far superior.

"It required 18 hours to grind and polish the mirror, and many more to produce the required correction. To my great surprise the silvering proved to be the most obstinate problem of the entire process, although I had experienced no trouble silvering my first mirror. It cost five dollars for materials and much worry and study before the desired degree of success was obtained. (An average experience. Silver is fickle.—Ed.)

"The mounting is of the conventional design of Mr. Ions. This was adopted because it could be constructed with very little machine work. A portable mounting should be as light as possible, and for this reason I constructed the counterweight on an extension of the declination axis, which permitted the use of a comparatively light weight and enabled the mounting to be more easily moved. This telescope gives perfect definition and shows a beautiful image of Saturn or Jupiter.

"I have doubly profited by my experiences as an amateur telescope maker. The construction of the mirror itself was so intensely interesting that I would feel repaid if there was no result other than the production of a perfect paraboloidal curve. But I have also been admitted into the wonders of the heavens. Before I constructed my first telescope I neither knew nor cared anything for astronomy. I now spend many evenings in exploring the sky, and although I do not know much about the movements of the celestial bodies as yet, I am diligently studying the science and hope to learn more."



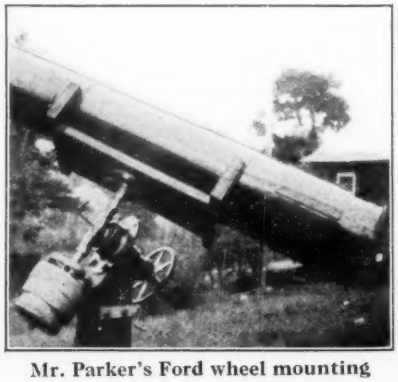
Mr. King and his six-inch reflector

Mr. E. T. King, 301 West Lincolnway, Jefferson, Iowa, sends us a photograph of his six-inch telescope. This is the Springfield type. His method of supporting the polar axis, as shown in the illustration, is unique.

What the average newspaper reporter will do is, of course, beyond scientific, or even unscientific, prediction. One Des Moines Sunday paper states that Mr. King can now sit in his back yard and "speculate what forms of civilization the moon and stars have"! Still, this is little worse than a claim made by one of our readers—a telescope maker, at that—who is certain that he sees volcanic eruptions on Capella! He also claims he sees vegetation and what-have-you! He does not seem satisfied with our suggestion that he clean his eyepiece and read up on the theory of resolving power. The sun is the only star on which even the most powerful telescope will reveal detail; or, in fact, even the actual disk itself.

Mr. P. O. Parker, Cohutta, Georgia, is the first to make use of a Ford *front* wheel assembly for a polar axis. He writes: "I enclose a photograph of my telescope which was made according to the instructions in the book 'Amateur Telescope Making.' I had quite a bit of trouble figuring the six-inch mirror, but finally got a fair job. With eyepieces of one inch, one half inch and one fourth inch it gives excellent results on the moon and planets, and fairly good on double stars.

"The mounting was made from a Ford front hub assembly. The upright was cut at proper angle for latitude, and hub bolted to it for polar bearing. The spindle acts



Mr. Parker's Ford wheel mounting

as declination bearing. The declination axis was the only part requiring any machine work, and it very little. The counterweight was moulded of babbit. The wheel just above the counterweight is a declination clamp. A four and one half dollar worm and gear from the Chicago Stock Gear Works, whose advertisement appears in each issue of the SCIENTIFIC AMERICAN, made an excellent slow motion in right ascension. The entire mounting and work cost about ten dollars."

This front hub assembly stunt impresses us as an ingenious arrangement. It provides a fitting funeral for a model T Ford.

Dr. J. J. Byl, 430 South 13th Street, San Jose, California, writes that he is experimenting with lunar photography, using the telescopes he described in the issue of last February, on page 177. As others are no doubt doing the same thing it is hoped that a number of photographs of the moon will be sent in for publication in some one issue. Another issue will be devoted to spectroscopes, providing enough photographs of those made by amateurs reach us within a few months. Next month's space will be devoted largely to grinding and polishing machines made by amateurs.

A six-inch fork type mounting made by Frank Murray, 404 Mission St., St. Marys, Kansas. The extended fork permits view of the celestial pole. On large sizes the overhang might cause flexure and vibration, as it is quite extensive

This month we have altered the standard heading of our department from "The Back Yard Astronomer" to the form you see at the top. This does not, however, mean we have become too "high hat" to inhabit the back yard during our observation periods; in fact, we have retained Porter's sketch of the typical back yard with all the trimmings. "The Amateur Astronomer" gives us a little more scope and dignity—as if we needed that quality!

We are making a collection of the inevitable misprints and errors found in A. T. M., as it is desired to compile an erratum sheet. We therefore request those who have found any such slips to advise us, as

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Agents Wanted in this Section

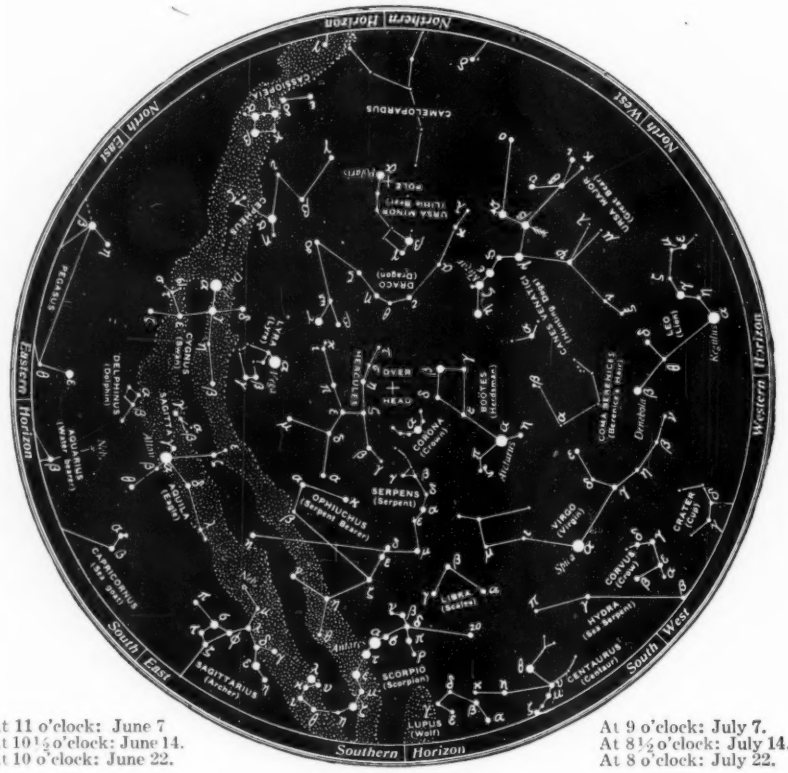
there are doubtless some which we have missed.

Amateurs in Pittsburgh have been organized into a club which meets on alternate Sundays at the homes of the different members. The president of this club is Chester B. Roe, 624 Hemlock Street, Avalon, Pennsylvania.

Now that Old Man Winter is off the job, Young Man Mosquito is on. The amateur astronomer is beset with troubles the year around—unless he happens to live in California or places where neither nuisance exists. Ye Tel. Ed. undergoes two annual changes of mind in this regard: in summer, when slapping the famous Jersey mosquito between short peeps at the eyepiece, he thinks there will at last be peace when cold weather comes; but in cold weather he must slap still harder to prevent death by freezing. Maybe, after all, the best place to be is down cellar, making more telescopes to try out later and discover that the cold or the mosquitoes render it advisable to retreat to the cellar and make another telescope to . . . Well, why *do* we amateurs make telescopes, anyway?—*A. G. I., Tel. Ed.*

The Heavens in June

By PROF. HENRY NORRIS RUSSELL, Ph.D.



At 11 o'clock: June 7
At 10½ o'clock: June 14.
At 10 o'clock: June 22.

At 9 o'clock: July 7.
At 8½ o'clock: July 14.
At 8 o'clock: July 22.

At 9½ o'clock: June 30.

The hours given are in Standard Time. When local summer time is in effect, they must be made one hour later: 12 o'clock on June 7, etc.

NIGHT SKY: JUNE AND JULY

MERCURY is an evening star at the beginning of June, but is too near the Sun to be observable. On the 18th he passes through inferior conjunction and becomes a morning star. By the end of the month he is well visible rising before 3:30 A.M.

Venus is a morning star and very brilliant. She rises about 2:30 A.M. on the first and just before 2 o'clock on the 30th (by standard, not by daylight saving, time).

Mars is an evening star setting between 10 and 11 P.M. He is now nearly 200 million miles away and is not very bright.

Jupiter is a morning star rising nearly two hours later than Venus when the month begins, but only half an hour later at its close.

Saturn is in Sagittarius and comes to opposition on the 19th. Since at this date the Sun is very close to the northernmost point of his track in the sky, Saturn is close to his southernmost. He is nonetheless conspicuous and outshines considerably any star in the southern sky.

Uranus is a morning star in Pisces, and Neptune an evening star in Leo—both poorly placed for observation.

The moon is new at 9 A.M. on the 7th; in her first quarter just after midnight on the 14th; full at 11 P.M. on the 21st; and in her last quarter at 11 P.M. on the 29th. She is nearest the earth on the 8th and farthest away on the 22nd. During the month she passes Uranus on the 2nd, Venus on the 4th, Jupiter on the 6th, Mercury on the 7th, Mars on the 11th, Neptune on the 12th, Saturn on the 21st, and Uranus again on the 30th.

At 5 P.M. on June 21st the Sun reaches its greatest northern declination and in the old almanac phrase "Summer commences."

The Scientific American Digest

(*Continued from page* 542)

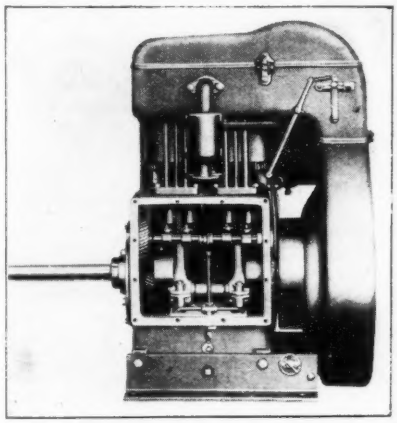
chinery for industrial plants, theaters and public gathering places all over the country, some of his most recent being the Capitol at Washington, the Paramount and Roxy theaters and the National Broadcasting Studios in New York City. It was logical that Mr. Carrier would direct his efforts toward developing a home "Weathermaker" for producing conditioned air, and this has now been designed. The cooler air, which collects near the floor of the house, is drawn down through return air grilles into ducts connected with the "Weathermaker" unit in the basement. Here the air is scrupulously cleaned by passing through filters comprising fine mesh wire, like a steel wool, covered with a viscous material which acts as a barrier to dust particles and the germs carried by them. It is then caught up by a motor-operated rotary blower and forced through a series of heating sections which are heated by gas fuel. The air is next humidified by passing over a humidifier capable of evaporating several gallons of water a day and is then distributed into every room of the house through ducts connected to register openings in each room. This process goes on continuously and is under automatic control as to temperature and humidity.

From the humidifying chamber, air is circulated through the house under pressure, but not forced sufficiently to cause a draft. It goes evenly to every room, and windows need not be opened at any time.

Scientists claim that by maintaining sufficient moisture by evaporation, a home may be kept comfortable at from two to seven degrees lower than usual.

Air-cooled Industrial Gasoline Engine

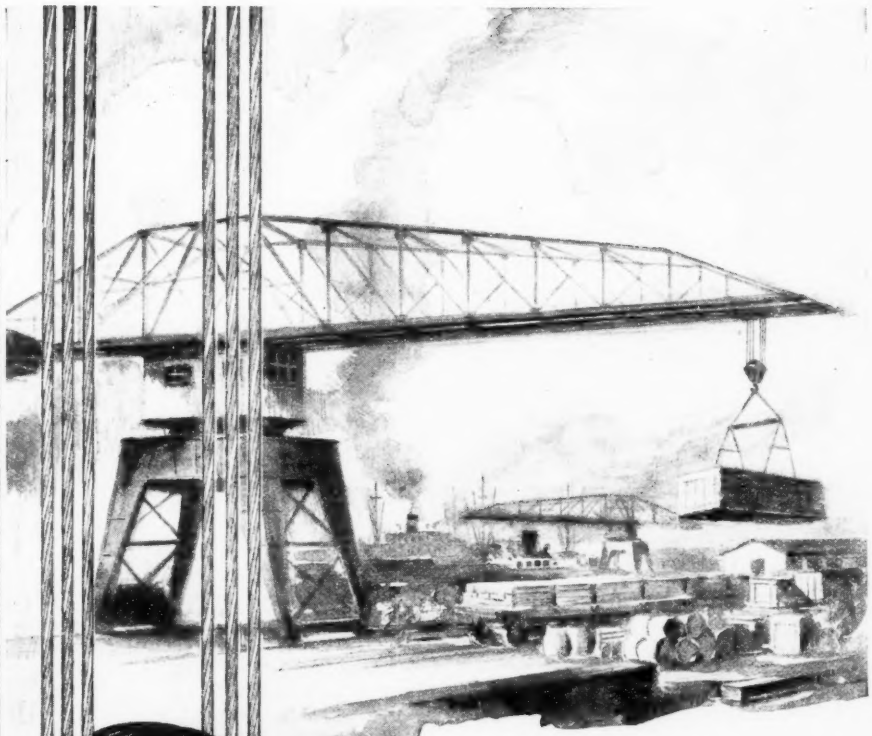
IN 1905 the first air-cooled engine was developed for industrial and foreign use by The "New-Way" Motor Company of Lansing, Michigan, and for 23 years this company has consistently stood by its



Small air-cooled gasoline engine rated at six to ten horsepower

conviction that the air-cooled engine would eventually come into its own and the possibilities of light weight together with simplicity of construction would force a recognition of this type of engine for certain classes of work which could not be satisfactorily handled by a water-cooled engine.

There is no question regarding the ability of air-cooled engines to deliver satisfactory



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service; in fact, the latest and highest type of power, aircraft motors, may be said to represent the last word in mechanical knowledge, and the seal of approval affixed to air-cooling by aircraft engineers settles for all time the debate on water versus air-cooling.

In the new twin-cylinder six to ten horsepower engine, announced recently, there are no water pipes, radiator fins, or other parts necessary to water-cooling. It is a valve-in-head type with detachable cylinder head. A large inspection plate may be removed, exposing all moving parts. A distinctive feature is the ease with which pistons may be removed and replaced through the inspection-plate opening. Roller bearings, air-governor, Eisemann special flywheel magneto, Tillotson float feed carburetor and air cleaner, and Lynite connecting rods are standard equipment on this new engine.

The flywheel is provided with a series of curved blower blades around its periphery, and as it turns it creates a partial vacuum in the wheel housing. The strong suction effect draws air in and down through the cylinder jackets. The air currents pass over and between the flanges at fairly high velocity, and as there is a large amount of exposed surface, the excess heat is promptly disposed of, being absorbed by air passing around the cylinders, which is ejected from the motor compartment by the action of the blower flywheel.

Insulating L. O. X.

AN unusual instance of the help received in one field of scientific progress by the advancement at the same time in another occurs in the development of the explosive L. O. X. and the part insulation has played in making this product available commercially.

L. O. X. consists of finely divided carbon, such as lamp black, put into cheese-cloth bags and soaked with liquid oxygen. Because there is no ash, and because the carbon and oxygen combine to form harmless carbon dioxide gas, this was apparently an ideal explosive. There was, however, one seemingly insurmountable difficulty in making it a success for mines and quarries where small liquid oxygen plants were to be installed. It was necessary, after putting the carbon cartridges in an insulated chest on wheels, to fill the chest with liquid oxygen and to saturate the cartridges. No insulation, however, was found which had enough efficiency to prevent the evaporation of the liquid oxygen, the temperature of which is 293 degrees below zero.

Those interested in this explosive, after repeated tests, discovered that Dry-Zero insulation, itself a recent scientific achievement in the insulation field, when used to insulate the chests proved 100 percent more efficient than any other material used, and since the adoption of this insulation for this purpose, L. O. X. has progressed rapidly and successfully.

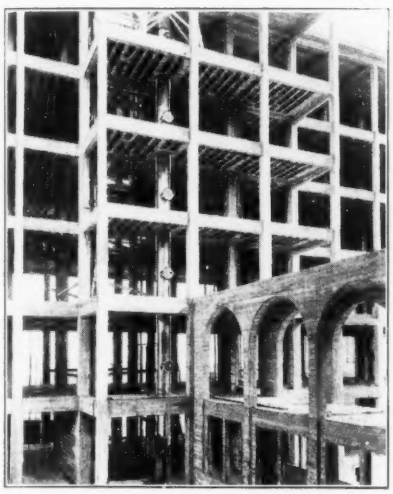
Soiled Linen Chute in Hospital

SANITARY methods of handling soiled linen in hospitals is now recognized as an essential feature in properly protecting patients and employees. The installation of an aluminum soiled-linen chute was made at the N. H. D. V. S. Hospital at Sawtelle, California, and extends for the

length of six stories as shown in the accompanying photograph.

A sheet aluminum throat is furnished for the intake at each floor and is extended through the partition wall to the door jamb casting outside the wall. The door consists of a cast aluminum ring, set with wire glass center, closing against a rubber gasket. The hinge is a heavy pin through strong lugs cast as parts of the door jamb and door casting, and the door is forced tight against the gasket by a refrigerator door clamp.

At the bottom, very rigid construction and heavy reinforcement give ample strength for deflection of bags of laundry by a slanting bottom to the side discharge. A steel leg is provided for supporting the bottom of the chute.



Concrete skeleton of hospital, showing the soiled linen chute

The use of aluminum in the construction of the soiled linen chute allows for cleansing with the flow from a spray pipe or with disinfectants applied with a long-handled brush inserted at intake openings. Furthermore, aluminum does not rust.

Nobody Can Make it Rain, Says Weather Bureau

SOME years ago a man went through certain drought-stricken regions in this country contracting to produce an inch or more of rainfall for a consideration of 1000 dollars per inch within a period of three months. If the rain came, the fees were collected; if it did not, the man lost nothing. Inasmuch as the average amount of rainfall for each region is accurately recorded, and since precipitation is quite likely to occur naturally after a long drought and within the limits of the record, a shrewd operator is fairly safe in agreeing to "produce" rain.

But according to the Weather Bureau of the United States Department of Agriculture, "rain making" is impossible for any human being. It is quite true that in the laboratory a small amount of moisture can be precipitated by using special equipment, but meteorologists know of no practical scheme for producing rain on a large scale. Widespread drought is due to lack of sufficient moisture in the atmosphere and the absence of other conditions essential to the formation of rain. If there is little moisture to bring down, obviously no device for causing rainfall has

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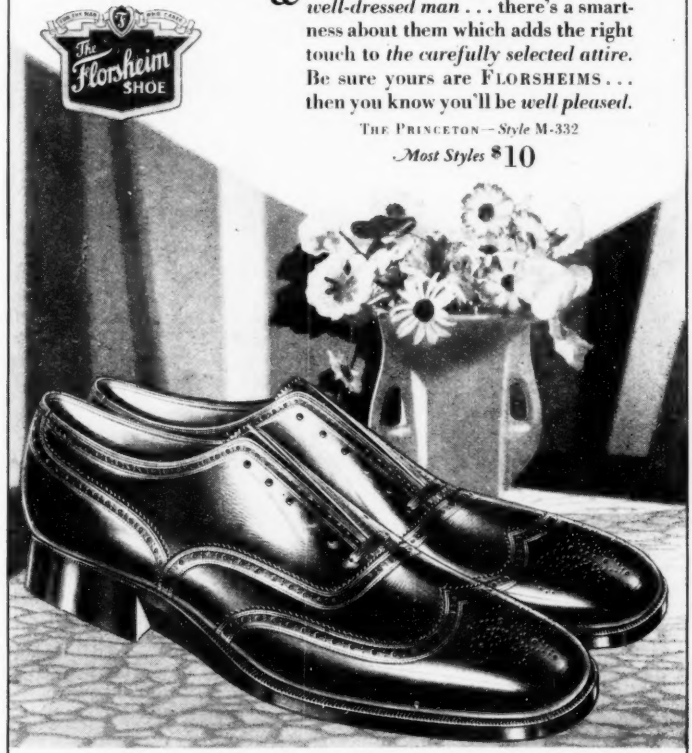

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any value; moisture cannot be "manufactured."

Looking at the matter another way: To produce one inch of rainfall over an area of an acre, approximately 113 tons of moisture would have to be drawn up into the air and then precipitated! There are 640 acres in a square mile, for which 72,320 tons of moisture would be required. A square mile, however, would be scarcely a dot in the center of any section where drought prevails. It would be less than one seventieth of the area of the District of Columbia. Enormous quantities of energy are used in nature to elevate moisture above the earth before it can be precipitated. It takes 5,000,000 to 10,000,000 horsepower-hours to evaporate the water in a square mile of the average dense cloud, and even if some artificial means were found to cause the aggregation and fall of the infinitesimal drops of which rain is made up, calculation shows that only a trifling amount of precipitation would result, because there is not much water in a cloud.

Wanted: Cure for Forestry Problem

PRIZES of 1000 dollars and 250 dollars have been offered by the Society of American Foresters, 930 "F" Street, N. W., Washington, D. C. for the best essays describing the present forestry situation and proposing a nation-wide remedy for its solution. The contest closes in September.—*Science Service.*

Adhesive Tape Wrapping Stops Serious Tree Ills

ORDINARY adhesive tape, used for emergency mending on everything from a cut finger to a punctured tire, proves to be the long-sought means for saving millions of young trees in nurseries from crowngall, root-knot, and similar malformations. The discovery was made by Professor A. J. Riker and his associates, of the University of Wisconsin.

The germs of crowngall and similar tumorous diseases of plants, which have caused heavy losses for years in the nursery business, get into newly made grafts through the freshly cut surfaces which are normally supposed to grow together in a smooth union. The usual types of wrapping used on grafted trees fail to keep them out. But an overlapped wrapping of adhesive tape excludes them effectively and permits success with over 90 percent of all grafts made, Professor Riker reports. —*Science Service.*

"New Navigation Tables for Mariners and Aviators"

A SHORT and quick method of working problems in celestial navigation which gives a rapid and accurate method of finding the position for ships as well as of planes, has recently been published by the Hydrographic Office, Navy Department, under the above title. It is so small in size as to be easily carried in a side coat pocket and so handy and simple to use that a navigator in a small life-boat can find his position as accurately as if he were on a high-speed ship with a library of navigation books at his disposal.

These tables will probably supersede all the old ones now in use because of utility, simplicity, and accuracy of results, for aviators, submarine officers, yachtsmen, and navigators of all small craft. All that

HOW

can you solve your intimate personal problems of happiness and unhappiness? How can you overcome bad habits? How do you get the impulse to steal, to murder? How can your emotions make you ill? How much of your brain do you use? How does your job fit you? How can you be happy though married? In short, How do you get that way?

WHY

don't your parents understand you? Why don't you make more money? Why do you have headaches? Why can't you help taking a chance? Why are there so many celibates, divorces, mismated couples? Why do you sleep so much? Why do you fall out with people? Why do you fall for some people and not for others? In short, why aren't you the happiest person alive?

WHAT

holds you back from your desires in love and work? What is the cause of suicide? What was the matter with your school teachers? What might cause your marriage to be unhappy? What causes frigidity in women? Father love? Mother love? Jealousy? Temper? Tears? What should every new-born have? What should every mother know? What is wrong with your mind? In short, what makes you the way you are?

YOU

will find the answers to these and thousands of other intimate personal questions in the great new book HOWS AND WHYS OF HUMAN BEHAVIOR, by the famous doctor and scientist, George A. Dorsey. 500,000 people read his best-seller WHY WE BEHAVE LIKE HUMAN BEINGS, and thousands of them wrote to him asking him the questions they could not ask their family physicians, questions about the things they hid from the world. In this great new book, he will tell you WHY your life has not been what you hoped for, and HOW to get the things you want in life. Sign the coupon now, mail it today, and the book will come to you for five days free examination. Then, if you do not find thousands of helpful suggestions, return it to us and it has cost you nothing.

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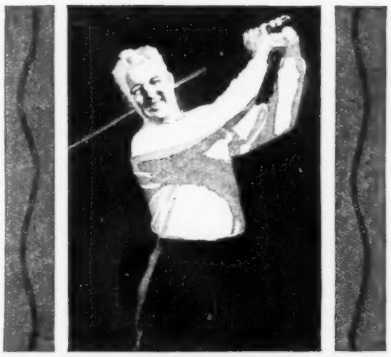

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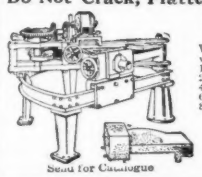

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is required in addition is the Nautical Almanac, a sextant, and a watch. The Nautical Almanac is the publication of the United States Naval Observatory which gives the celestial co-ordinates of the heavenly bodies as used by navigators.

Aviators herald the publication of this book because the space in an airplane is so limited that hitherto it was often impossible to carry the larger and heavier books in the cockpit. Thus many have been known even to attempt sea flights without the proper navigation tables, trusting to luck or sense of direction to lead them to their destination.

The formulae upon which the tables are based, were deduced and the method evolved by Lieutenant Commander J. Y. Dreisonstok, U. S. N., while a member of the Naval Examining Board when he realized the trouble young navigators had with the old, long, and tedious methods of solving the astronomical triangle, and their dread of logarithms. So he was later attached to the Division of Nautical Research in the Hydrographic Office, where he completed the calculations and put them into the present form.

For utilization of this method one must, of course, know the rudiments of navigation. A background such as given in H. O. Publication number 9, "The American Practical Navigator" by Bowditch, makes it very simple, for this is not a text book on navigation, but *tables* for the use of navigators and aviators.

The method of solving navigational problems is applied without variation to all problems regardless of the position of the heavenly body, be it sun, moon, planet, or star. It requires few figures and gives a quick solution for determining (a) line of position, (b) compass error, (c) medium altitude, (d) great circle course and distance, and (e) identification of unknown stars. The precision of the tables is within 0.′ 1.

While a small and handy size book is desirable, space is given at the end to a full explanation of the construction of these tables together with numerous problems in order that an opportunity for analysis may be afforded those who desire to investigate their soundness and use.

The tables extend from 0 degrees to 65 degrees in latitude, but the Hydrographic Office has prepared for the special use of Commander Richard E. Byrd, U.S.N., tables for latitudes up to and including 90 degrees. With the extension of the tables, a navigator can pilot his ship or plane from the equator to the poles.

Down-Stairs "Skyscraper" Planned for Tokyo

THE child's conception of things in the Orient being topsy-turvy is upheld by a Japanese project for a downstairs "skyscraper," 80 stories deep. This building, which would be built down into the earth 1100 feet, is designed in defiance of earthquakes.

This world's deepest building is planned for Tokyo, where earthquake proof architecture has been a serious problem ever since the disastrous quake of 1923. Designs for the building are in the form of a huge circular well of steel framework. Elevators, ventilating airshafts, telephones, and electric lights are provided for. The cost is set at about 11,000,000 dollars. The Shin Nippon Construction Company is interested in the project.—*Science Service.*

Did You Ever Take An INTERNAL Bath

By M. Philip Stephenson

This may seem a strange question. But if you want to magnify your energy—sharpen your brain to razor edge—put a glorious sparkle in your eye—pull yourself up to a health level where you can laugh at disease and glory in vitality—you're going to read this message to the last line.

I speak from experience. It was a message just such as this that dynamited me out of the slough of dullness and wretched health into the sunlit atmosphere of happiness, vitality and vigor. To me, and no doubt to you, an Internal Bath was something that had never come within my sphere of knowledge.

So I tore off a coupon similar to the one shown below. I wanted to find out what it was all about. And back came a booklet. This booklet was named "Why We Should Bathe Internally." It was just choked with common sense and facts.

What Is An Internal Bath?

This was my first shock. Vaguely, I had an idea that an internal bath was an enema. Or by a stretch of the imagination a new-fangled laxative. In both cases I was wrong. A real, genuine, true internal bath is no more like an enema than a kite is like an airplane. The only similarity is the employment of water in each case. And so far as laxatives are concerned, I learned one thing—to abstain from them completely.

A bona fide internal bath is the administration into the intestinal tract of pure, warm water, Tyrrellized by a marvelous cleansing tonic. The appliance that holds the liquid and injects it is the J. B. L. Cascade, the invention of that eminent physician, Dr. Charles A. Tyrrell, who perfected it to save his own life. Now here's where the genuine internal bath differs radically from the enema.

The lower intestine, called by the great Professor Foges of Vienna, "the most prolific source of disease," is five feet long and shaped like an inverted U—thus ∩. The enema cleanses but a third of this "horseshoe"—or to the first bend.

The J. B. L. Cascade treatment cleanses it the entire length—and is the only appliance that does. You have only to read that booklet—"Why We Should Bathe Internally" to fully understand how the Cascade alone can do this. There is absolutely no pain or discomfort.

Why Take An Internal Bath?

Here is why: The intestinal tract is the waste canal of the body. Due to our soft foods, lack of vigorous exercise and highly artificial civilization, nine out of ten persons suffer from intestinal stasis (delay). The passage of waste is entirely too slow. Result: Germs and poisons breed in this waste and enter the blood through the blood vessels in the intestinal walls.

These poisons are extremely harmful. The headaches you get—dizziness—the bad odor of perspiration—the sluggish responsiveness of both mind and body—failure to get most out of life and many other conditions are directly due to the presence of these poisons in the system. They are the generic causes of high blood pressure, rheumatism and other serious maladies.

Thus it is imperative that your system be free of these poisons. And the only sure and effective means is internal bathing. In fifteen minutes it flushes the intestinal tract of all impurities. And each treatment strengthens the intestinal muscles so the passage of waste is hastened.

Taken just before retiring, you will sleep like a child. You will rise with a vigor and satisfaction that will insure your doing all the strenuous things your friends will want to do.

Just one internal bath a week will remake glorious vibrating health. That is not my experience only. It is the experience of over 900,000 men and women.

Send for this Booklet

It is entirely FREE. And I am absolutely convinced that you will agree you never used a two-cent stamp to better advantage. There are letters from many who achieved results that seem miraculous. As an eye-opener on health, this booklet is worth many, many times the price of that two-cent stamp. Use the convenient coupon below or address **Tyrrell's Hygienic Institute, Inc., Dept. 476, 152 West 65th Street, New York City.**

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Send me, without cost or obligation, your illustrated booklet, "*Why We Should Bathe Internally*" on intestinal ills and the proper use of the famous J.B.L. Internal Bath.

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Chemistry in Industry

(*Continued from page* 553)

types. Today over 100 domestic oil heaters are sanctioned by the fire underwriters.

Copper, mainly in the form of its alloy, brass, is used for approximately 100 parts of the various assemblies in the several types of equipment. As much as 25 pounds of brass is used in some types of domestic apparatus, with an average of ten pounds of brass and two of copper. Some models of industrial equipment use 50 pounds of brass, and average 17 of brass and three of copper.

The present rate of development in the oil-heating industry points to a copper consumption totalling seven million pounds per year in the production of parts for oil heaters.

Chemistry and the "Bright Lights"

"A FEW years ago it seemed impossible that a gas so rare that only one part occurs in every ten thousand parts of air could have the effect on advertising that has developed through the better knowledge of the properties of neon gas," says Joseph H. O'Neil, writing in a recent issue of *Chemical and Metallurgical Engineering.* "The most obvious results of the development of neon, argon, and helium are glowing colored tube electric advertising displays and signs that dot the avenues of all the larger American cities.

"These gases occur in exceedingly small concentrations, neon –0.001 percent, argon –0.93 percent and helium –0.0005 percent. This readily indicates to those who are familiar with gas extraction processes that their extraction from the air requires a highly developed technique.

"They are customarily recovered as a part of the process of the rectification and separation of air for the production of oxygen and nitrogen.

"For the purpose of advertising displays, the gases are inclosed in glass tubes containing an electrode at each end, the gas acting as the conducting medium. The electrodes are cylindrical in shape and made of copper. A lead glass is generally used for the tubing, since it is easiest to work. After the tubing has been bent into the desired design and the electrodes sealed in, it is evacuated as far as possible with Langmeir and Eisler pumps. To drive all air out of the electrodes and walls of the glass tubings the electrodes are bombarded by means of a current at 16,000 volts. This is repeated three times to remove the last traces of air, which must be absent before introducing the gases.

"The tubes are then cooled to room temperature and the gases are introduced. This is accomplished by sealing the tubes in a line in which are the reservoirs of neon, helium, or argon and a pressure gage. The gas or gasses, depending upon whether a single gas or a combination of gases is desired, is or are then allowed to flow into the tube until a desirable pressure is obtained. The pressure varies with the different gases, in the case of neon a final pressure of over seven and one half millimeters is used, while twice that pressure is desired in the case of other gases.

"The tubes are then removed from the line and further purified by 'aging.' This process consists of applying a low voltage and requires from five or ten minutes to 24 hours, depending upon the length of

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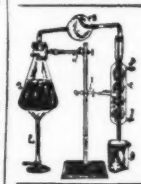

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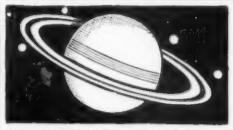

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time required to bring an entire tube to a uniform color. It is at this point that the mercury is added if desired and distributed throughout the length of the tube. The tube is then ready to be put in place on the metallic framework of the sign.

"The various colors are obtained by using individual gases, combinations of gases and mercury vapor, and colored glass. Almost any color and tone can be produced by these means. The colored glass most generally used is a yellow lead glass. The most generally used of all the colors is the orange red, which is a white glass tube containing neon; yellow or golden is yellow glass containing helium; green is the yellow glass tube containing neon and mercury vapor; blue light is secured primarily from vaporized mercury, mixed with either neon, argon, or some other gas. Lavender, white, and other lights are possible from mixtures of various rare gases."

Corrosion Proofing Gives Dark Colored Surface

REPORTS of a new corrosion-proofing process come from Germany. It is known as the Jirotka Immersion Process. This procedure consists in dipping the articles to be treated in solutions of complex metallic salts, as of cobalt, nickel, and manganese. These solutions vary in composition according to the object in view. In most cases there is a subsequent treatment in galvanic baths.

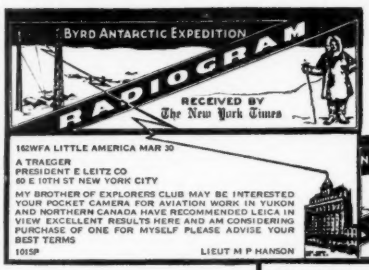
This process is particularly useful for automobiles, airplanes, illuminating equipment, and the like, which thereby acquire a permanently attractive appearance and become corrosion-proof. The coatings produced by the Jirotka process do not have a metallic character but resemble ebony or are mahogany colored and are distinguished by their great variety of color shades. The process has proved particularly successful for the treatment of light metals, especially aluminum.

Banana Vinegar!

"BANANA oil" has an established place both in the lacquer trade and in current slang, but now we are introduced to banana vinegar. Mr. Harry von Loeseke describes its manufacture in a recent issue of *Industrial and Engineering Chemistry*.

Banana vinegar has been successfully made on a laboratory scale. Color, aroma, and taste were pleasing. The method of production was to make a mash from the pulp and peel of ripe bananas, pasteurize at 75 degrees, Centigrade, for 45 minutes, cool, and inoculate with a pure culture of *Saccharomyces ellipsoideus*. After vigorous fermentation began (about three days at 20 to 23 degrees, Centigrade) this mash was used as a starter for a larger quantity of pasteurized mash.

The pasteurization is necessary because banana mash abounds in acetifying bacteria, which must not be allowed to act in the early stages of the process. Acetification was effected by trickling the fermented liquor over beechwood shavings which had been boiled in water, and dried and soaked in strong vinegar; but control of air supply was too difficult in the small laboratory apparatus. Better results were obtained by the Orleans process, in which the fermented juice is brought to a suitable acidity for bacterial acetification by addition of strong vinegar.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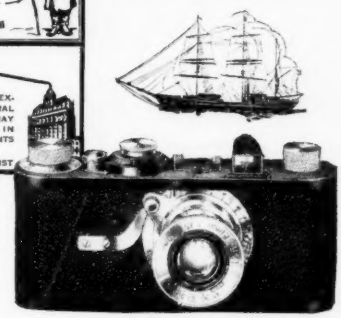

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Commercial Property News

Facts and Notes of Interest to Inventors, Patentees, and Owners of Trademark Rights

State Royalty Tax Held Illegal

INCOME from royalties derived from patents or copyrights issued by the United States government are not taxable under the state personal income tax law of New York, according to a recent ruling based on a decision of the United States Supreme Court. The decision is based on the case of Long *versus* Rockwood, in which the Supreme Court held that a state may not take royalties from United States patents or copyrights for the reason that such taxation would involve interference with functions of the government.

Considerable discussion in legislative circles has resulted from the decision, for if the ruling is retroactive, it may result in demands from many authors and inventors for refunds from income tax payments made on royalties received in the past. Taxes have been collected by the state on royalties, some of which are reported to have amounted to hundreds of thousands of dollars.

Other states having royalty taxes on incomes from patents and copyrights will be in the same positon as the state of New York, if the decision is judged retroactive. In that event, a flood of demands for refunds may be expected from authors and inventors who have paid taxes illegally.

Process for Breaking up Oil Emulsions Denied Patent

DESPITE the fact that the oil industry is now burdened annually with some 2,000,000 barrels of intimately mixed oil and water, which apparently cannot be separated despite repeated attempts and years in storage, a practical method of separating the liquids into strata has been adjudged no novelty.

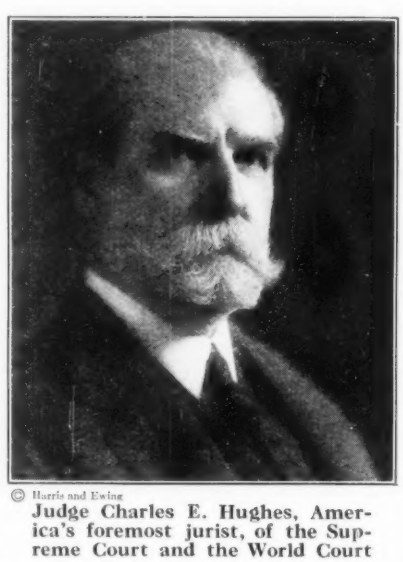
A patent was issued January 29, 1929, to Samuel Warren Cole for a process of recovering oils from emulsions. The decision of the Examiner rejecting certain claims covering such a process was confirmed on appeal. The Board stated that there was nothing inventive involved in the process, which dehydrates the emulsion by means of a chemical reagent combining with the water and breaks up the emulsion, allowing the oil to be recovered.

The invention relates to a process for treating natural crude petroleum with a chemical, calcium carbide or sodium, in such a way as to release a small fraction of the water surrounding minute globules of oil or water in a film, so that the emulsion is broken up into strata. Heat may or may not be used in the process, and the chemical used may combine with the water in the emulsion to produce heat, which reduces the viscosity of the oil and materially aids in the precipitation of the water.

The Board of Appeals of the Patent Office held that there is nothing inventive involved in the process, and that the same process, carried forward to generate an indefinite quantity of acetylene gas insufficient to completely dehydrate the emulsion, is utilized in patents on record. The references relied upon are: De la Roche, May 30, 1899; Benkendorf, January 23, 1912; Schreiber, February 7, 1922; and Vittenet (France), July 25, 1903.

Charles Evans Hughes Addresses Patent Attorneys

HUMBLY confessing his trepidation at appearing before "the assembled erudition of the Patent Bar," the Honorable Charles Evans Hughes recently addressed the New York Patent Law Association at its annual dinner in New York City, where he was the guest of honor. Mr. Hughes, who has been awarded the greatest honors the world can bestow upon its jurists, commented on the incomprehensible language used by patent attorneys, and the fascination and importance of their work.



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Judge Charles E. Hughes, America's foremost jurist, of the Supreme Court and the World Court

Answering those critics who complain about the law's delays, the distinguished jurist called attention to the delays of legislatures in effecting solutions to even the simpler problems. The long struggle to secure an adequate number of judges in certain localities was mentioned, with the trenchant comment, "We may have debates over what the law ought to be, but there should be no serious conflict of opinion in providing the judicial machinery to enable suitors to invoke the laws we have."

It was pointed out that, "there were pending in the Southern District of New York, on the civil side of the court, 2270 cases in admiralty, 2154 in law, and 861 in equity. It was estimated that it would take two years to reach an admiralty case for trial, and 18 months to go to trial in law and equity. In addition, there is the work of the criminal and bankruptcy parts and the motion calendar. The six judges of the district court cannot perform this work. They are under the greatest pressure in mind, body, and estate. Judges from other districts have been brought here to help them out."

Touching on the importance of selecting judges for the Federal courts with the utmost discretion, the guest of honor said, "The solicitations and intrigues of politics should have no place. Character, learning, experience, and tact are the qualifications for the Bench. The best guarantee of fitness is sound professional reputation. The prestige of the Bench is largely dependent on the distinction of those who are appointed to it, and it should always be remembered that a good judge is the community's most important asset."

Dr. Georges Claude Discusses Invention

SKETCHING the fundamental principles underlying success in research and invention, the distinguished French inventor, Dr. Georges Claude, sets up a number of helpful guide posts for others who may be possessed of an inventive turn of mind. In an article entitled, "Ideas of An Inventor," which appeared in a recent issue of *The Tech Engineering News* (Massachusetts Institute of Technology), Dr. Claude presents the essence of the inventive philosophy. His own contributions to science include the discovery of acetone as a solvent for acetylene, processes for liquefying air and for the fixation of nitrogen, and the familiar Claude neon light tube. Like most inventors, he enthusiastically declares that his present work is to be his greatest achievement. Perhaps he is justified, for he can claim to be on the verge of harnessing the almost limitless energy of the ocean to run turbines.

"There are many persons who believe that the more science advances and the more industry progresses, the less remains to be invented," Dr. Claude declares in commenting on the field for invention. "On the contrary," he continues, "every new resource, every new invention, is able to combine with some of the other existing possibilities to permit many other combinations. This is not a question of opinion or feeling, it is an absolute, mathematical certainty; so that contrary to the opinion just mentioned, we ought to believe that our power of realization increases constantly, quickly, and indefinitely—the rapidity of modern progress is nothing other than the confirmation of this fact.

"But if the first need of an inventor is an absolute and solid confidence in the innumerable resources placed at his disposal by nature and science, it does not follow that he can use them without discrimination. Getting the result needed from a thing or a substance poorly fitted for that purpose is no longer worthy of science, when it is probable that far better things or substances or combinations can be found to suit that purpose in the immense and ever growing arsenal of the properties of matter

and energy. In that respect, we may venture to say that it is probably heresy for us to do a single thing now as it was done a century ago.

"It follows from all this that, in my opinion, the difficulty of an inventor is not to make an invention, but to choose from among the multitude of inventive ideas which strike his mind the one which is really worth while. This is all the more so since the achievement of a small invention frequently proves to be as difficult as that of a greater one. . . . It follows, further, that for any problem, a simple solution only is worth considering. A rule to which I tie my mind the best I can—for an inventor's mind is a fiery steed which often leads its master where he would prefer not to go—is to stray from the usual paths, in the simple belief that the less frequented is the way, the greater are the chances of meeting unknown and important things. This, of course, is not invariably true; many times interesting inventions are made in the most explored fields. But the probability of making important discoveries is better in less explored fields."

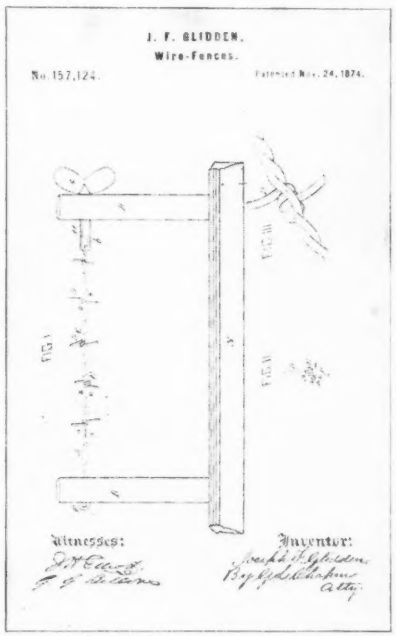
However, Dr. Claude recognizes the inherent obstacles in pursuing such a course. "I agree that this way is not without some serious drawbacks," he says. "It may happen, for instance, that proceeding along a new road one may make such an advance as compared to that which has been done before, that the result obtained does not correspond to an existing need, or appears so fantastic to those engaged in ordinary pursuits that one is kindly advised to take a rest in some lunatic asylum. If you are inclined to find in these friendly remarks excitement and pleasure rather than discouragement, then all is for the best."

No finer example of this is found than in Dr. Claude's own work. His early research in connection with dissolved acetone, liquid air, oxygen, and hydrogen, led finally to the utilization of the rare gases, particularly neon. From 1907 to 1913 Dr. Claude patiently developed his process for neon lighting. His long wait for recognition of its importance is best expressed in his own words.

"It happens, as I said before, that too new a question often pays for its novelty by having no existing need. And, this time, my hopes narrowly missed failing and the starting of neon lighting was very difficult. It was in Pittsburgh, at the Congress of the Illuminating Society of 1913, that I presented, for the first time in America, my neon tubes. The tubes I showed on this occasion were exactly like the present tubes as to their shape, their sizes, the intensity of their light. However, I could not succeed in arousing interest in them. Soon after came the war—and this matter of neon lighting had to wait until recent years before finding its way into America."

Speaking of his latest occupation, the development of thermic energy from the sea, Dr. Claude explains the basis for the common conclusion that among our present unemployed sources of energy, only solar heat is worthwhile. Apparently Dr. Claude and his colleague, M. Boucherot, originally held the same thought, for it was while engaged in solar research in the Sahara desert that the plan for utilizing the thermic energy of the ocean was conceived.

Even in the torrid regions of the desert one could not hope to get steam under pressure, in the common sense of the word. "However," explains Dr. Claude, "You know that water easily boils at any temperature below 100 degrees, Centigrade, in a boiler under reduced pressure from which the steam is continually removed as fast as it is produced by the suction of a condenser in which this steam is condensed by colder water. This steam, under a pressure of one atmosphere, can very well run a turbine on its way to the condenser. When thinking one day of the remarkable fact that deep sea temperature is everywhere, even in the tropics, near the freezing point, while the tropical sea surface water remains uniformly above 25 degrees Centigrade, an idea occurred to me that I should have considered foolish had it not been for this progressive training. The idea was that a difference in temperatures as great as 25 degrees and 4 degrees, Centigrade, would be sufficient to produce steam, to condense it, and to move turbines 24 hours a day and from the beginning to the end of the year."



Cattle damaged the crops of Joseph F. Glidden. His patent on barbed-wire made him a millionaire

Although appearances were far from encouraging, certain accepted formulae showed this hypothesis to be theoretically correct. With the aid of his young cousin, Andre Claude, he built a small turbine to test out the theory, and to their delight, the turbine ran at full speed. But then came a flood of criticism and argument, much of it from eminent specialists. "In short," Dr. Claude states, "it was a complete smashing of our proposals, for in spite of the past of both Boucherot and I, there were very few who, like your SCIENTIFIC AMERICAN, admitted that if this proposal could startle engineers, our past achievements ought to make them give us credit.

"So strong was this opposition—so true is it that objectors are too often the wreckers of progress—that I stopped all my efforts to organize a company, and decided not to go ahead before having proved our ideas at my own expense. This proof was given at Ougree in Belgium, in which a turbine of 60 kilowatts was successfully driven at 6000 revolutions per minute by the action of a difference of temperature of 18 degrees Centigrade. I have now but to prove that the difficulties of the installation at the sea are equally open to solution. For that purpose, I plan to have my Ougree plant transported to Cuba, where these ideas have met with the most cordial response, and to connect this plant with the cold depths by a convenient pipe as soon as I have ascertained the submarine currents, temperatures, and depth conditions in the vicinity of Havana, which I am now doing. After that I shall probably be in a position to pass to the realization of the first of our industrial plants, which shall be a 12,000 kilowatt installation."

Improving the Patent Law System

FROM time to time one hears rumors to the effect that the patent system of the United States is not perfect. No one denies that it has some good points, but many suggestions for its improvement have been made by both competent and incompetent critics of the system. Announcement has recently been made that a prize of 1000 dollars is to be awarded for the best essay or monograph on the subject, "A Complete Program for the Improvement of the United States Patent Law System."

The Faculty of Law of Northwestern University presents the announcement, as follows·

"The sum of 1000 dollars and a bronze medal, as a first prize, and two sums of 100 dollars each, as second prizes with honorable mention, will be awarded to the authors of the best essays or monographs submitted by March 1, 1930."

The award will be made by vote of the Faculty of Law; to be eligible for the award the author must be a member of the bar or a student registered in a recognized law school, or a patent agent in the United States of America, or in any other country of Anglican law. The Faculty reserves the right to make no award if in its judgment no work submitted is of sufficient merit. The first prize award will not be divided, but provision is made to enable the Faculty to make honorable mention of as many as two meritorious contributions not receiving prizes. The award will be made public in June, 1930, on the occasion of the annual meeting of the Alumni Association of the Law School. Details of the competition may be obtained from The Linthicum Foundation, Northwestern University Law School, McKinlock Campus, 357 East Chicago Avenue, Chicago, Illinois.

The contest is for the Linthicum Foundation Prize, which is awarded annually, when the contributions merit an award. The subject for the award in 1927 was "The Law of Radio Communication," and the prize was awarded to Stephen Davis, formerly Solicitor to the United States Department of Commerce. No award was made in 1928. The subject for the award of 1929 is "Scientific Property," and the prize will be awarded at the annual meeting of the Alumni Association of the Law School in June.

Change of Jurisdiction in Patent Appeals

ATTENTION is called to the fact that the newly-created Court of Customs and Patent Appeals will be governed, in so far as patent appeals are concerned, by the provisions of the revised rules which went into effect on April 1st. All patent and

trademark cases that were pending in the Court of Appeals of the District of Columbia have been transferred bodily to the new court. For the present, at least, the new court will follow the Rules of Procedure of the Court of Appeals of the District of Columbia, in so far as they relate to patent appeals.

Attorneys who are not members of the bar of the Court of Customs and Patent Appeals will have to arrange for admittance. This may be done either on motion of a member of that bar, or upon recommendation of a Federal judge or of a judge of the highest court of any state. Non-resident members may be admitted from time to time in the usual way, either on motion by an attorney of the court in open court, or by a letter of recommendation of a judge. A nominal admission fee is charged upon entry.

Patent Awarded Improved Paper Cup

FOR some time there has been a demand for paper drinking cups that will withstand the comparatively high temperatures of beverages such as coffee and hot chocolate. A patent has been awarded for a cup that is claimed to withstand temperatures of at least 150 degrees, Fahrenheit, utilizing a single layer of paper impregnated with a mixture of paraffin and carnauba wax. The carnauba wax is present in sufficient proportion materially to raise the melting point of the mixture, so that the cup is not quickly destroyed by the presence of hot liquids.

Another feature of the new paper cup is that there is no wax on the outside of the cup or on the rim. One trouble with the present type of paper cup has been a tendency to soil the hands or gloves of one handling it, and also a rather objectionable taste or odor. The waterproofing is applied only to the interior of the cup, under the new patent, and is substantially odorless and tasteless when in use.

James D. Reifsnyder, who was awarded the patent for impregnated paper drinking cups as described above, was also granted a patent on an apparatus for separating paper cups in a dispensing device. The Reifsnyder apparatus for dispensing nested cups makes use of a flange at the open end of the cup, and a cam for prying the flanges of the two lowermost cups apart. It was held that former patentees had not anticipated or contemplated the prying process for forcibly separating such cups, although one of them showed means of forcibly separating the lowermost cup from the stack by a pulling action on the body of the cup.

Another inventor, who discovered a method of making paper cups over 15 years ago, has recently been in court seeking to punish for contempt a former employee alleging that the employee had betrayed his secret process, in defiance of a court order secured by the inventor 14 years ago forbidding the employee to use or disclose the process. The inventor had not patented his invention, preferring to keep the process a secret.

The court was impressed by the circumstance that the inventor had waited for several years without applying for patents, and that the former employee had made proper application. It was held that the inventor was wrong in standing idle while his secret was being revealed in the Patent Office, and that he should have made his claim of wrongful use when the former employee sought the protection of the established agency of the Government. The motion for punishment was denied, the judge holding that the judgment of prohibition did not put a straitjacket on the ex-employee's brain. He was not required to abandon the inventive turn of mind although its exercise involved the use of the knowledge he had acquired in the inventor's shop.

Novel Coal Trademark Allowed

REVERSING the examiner's ruling, Assistant Commissioner Moore has allowed the registration of a trademark consisting of a combustile orange-colored disk bearing the words "Orange Disc," to be scattered among lumps of loose coal. The examiner's holding that the mark was merely a label or tag of a single color was overruled, and a distinction made between form or color of marks, and form, size, or color of articles to which they applied.

A label or tag identifies the goods; a trademark identifies the originator or owner of the goods, according to the ruling of the Assistant Commissioner. The applicant's mark does not identify the goods, for as there is no such thing as orange coal, or disk coal, or orange disk coal. The applicant's mark meets every requirement of a valid trademark, being arbitrary, fanciful, and non-descriptive of the goods.

In commenting on the decisions cited by the examiner, the Assistant Commissioner held that they merely decide the obvious fact that a label of a single color, apart from any name, figure, or device with which it may be connected, may not be the subject matter of a trademark. Otherwise any other person who might adopt a label having a similar color for the same class of goods would be chargeable with unlawful imitation.

Extended Research Wins Recognition

CLAIMS regarding the originality of an apparatus for promoting certain chemical reactions were sustained on the grounds that the invention was a product of many experiments and long research, in a recent infringement suit in which the validity of the patent was questioned. In the case of the Barrett Company *versus* the Seldon Company, the District Court for the Western District of Pennsylvania ruled that the patent held by the Barrett Company was valid and infringed by a similar apparatus designed to accomplish the same result.

The decision was based upon a finding that the patentee used materials and principles well known to those versed in chemical reactions, but that he combined them in such a way that a new and valuable result was obtained, as evidenced by the fact that the apparatus was completed only after numerous experiments and long pursuits of the basic ideas, and that the Seldon Company had replaced its apparatus with the type of device covered by the patent. The court ruled that the validity of the patent was established, and that since the defendant's apparatus embodied the essential ideas of the plaintiff's patent it constituted an infringement.

Patents Recently Issued

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Anyone desiring official copies of patents listed in this section, at 15 cents each, (state patent number to insure receipt of desired patent copy), or the address of a patentee, may obtain the same by addressing Munn and Company, Patent Attorneys, 24 West 40th Street, New York City.

Pertaining to Apparel

UNDERGARMENT—A form-fitting garment with every sanitary requirement, which will serve as the sole necessary undergarment for warm weather, except where a slip must be worn with very sheer dresses. Patent 1705399. Eva J. Goldenblum.

Chemical Processes

TREATMENT OF FELT AND FELT HAT BODIES—Particularly for increasing the lustre, and the firmness of velour felt hat bodies, by a 20 to 30% aqueous solution of meradole or like synthetic tanning agent, at a temperature of 60–80 centigrade. Patent 1705437. Erick Bohm.

Designs

DESIGN FOR A WHEELED TOY—Patent 77781. Edward W. Lawson.

DESIGN FOR A TELEPHONE CABINET—Patent 77865. George H. Supplit.

DESIGN FOR A DRESS—Patent 77974. David Minchenberg.

DESIGN FOR A DRESS—Patent 77739. Katherine E. Burns.

DESIGN FOR A SHOVEL—Patent 77900. Edward W. Lawson.

DESIGN FOR A DRESS—Patent 77986. Mildred C. Schmolze.

DESIGN FOR A TEXTILE FABRIC OR SIMILAR ARTICLE OF MANUFACTURE—Patent 77953. Herman Haug.

DESIGN FOR A NOSE BRIDGE FOR A SPECTACLE FRAME—Patent 77793. Vincent Tanasso and Jacob J. Pomeranz.

DESIGN FOR A GOBLET OR SIMILAR ARTICLE—The inventor has been granted three patents on ornamental designs, 77942, 77943, and 77944. George Dougherty.

DESIGN FOR A VENDING BOOTH—Patent 78010. James T. Crow.

DESIGN FOR A NOSE BRIDGE FOR SPECTACLE FRAME—Patent 78131. Vincent Tanasso and Jacob J. Pomeranz.

DESIGN FOR A COAT—Patent 78115. Dorothy Long.

DESIGN FOR A DRESS—Patent 78116. Dorothy Long.

Electrical Devices

ELECTRIC CONTROL SWITCH—Adapted to be secured at the upper end of a vertically disposed handle and conveniently operated by the thumb for controlling two circuits, so that either may be opened or closed. Patent 1703724. Clarence C. Crispen.

RADIO COMMUNICATION SYSTEM—Which reduces interference from atmospheric or other causes, and uses a single carrier wave to transmit a number of different messages or programs at the same time. Patent 1703719. Roy B. Bryant.

ELECTRIC WATER HEATER—So constructed that when, for any reason, there is no water in the tank, the thermostatic control will automatically open the circuit, and prevent the heating element from burning out. Patent 1705417. Charles F. Rogers.

ELECTRICAL WINDING—A conducting wire so wound that it functions to reduce to a minimum re-radiation and interference, increases selectively and sensitivity, and aids in maintaining the allotted frequency of a broadcasting circuit. Patent 1705396. Francis De Willy.

TERMINAL INSULATION COVER—For stripped or unraveled electrical conductors, may be quickly applied and will have a very neat appearance, tensionally holding itself in position. Patent 1705159. John H. Rouse.

TIME-CONTROLLED APPARATUS—Which permits the use of a conventional clock for automatically starting or discontinuing, at a predetermined time, a radio receiving set, or may be adapted to use on a phonograph. Patent 1705985. Reuben W. Lovering.

Of Interest to Farmers

SEPARATOR—For separating cream, the milk tank being constructed with a faucet and a notched bottom rim, so that when turned it will be raised above the edge of the supply funnel. Patent 1704658. John Degerth.

Of General Interest

MILK BOTTLE CRATE—Including a hollow body with end walls, side walls, and partition members, held together by metal cross rods, adopted to hold milk bottles either for deliveries or for washing. Patent 1703733. Henry A. Hamilton.

CONCRETE PILE—Having an upper formation for resisting driving blows, and an increased lateral frictional surface to resist any loosening tendencies, and thereby lend stability to the pile when driven. Patent 1703817. Charles E. Fowler.

METHOD OF MAKING IMITATION MARQUETRY, PARQUETRY, INLAYS, ETC.—Whereby an effect is obtained on a single surface of a variety of different woods, each separate section being so stained as to prevent the discoloring of any surrounding sections. Patent 1703746. James A. O'Neill.

LAWN SPRINKLER—Whereby horizontally disposed nozzles are so arranged as to turn the sprinkler parts about a vertical axis, due to the reaction of the water escaping to the air. Patent 1704610. Fred I. Jaden.

OIL CAN—Of the usual diaphragm bottom type, with mechanism whereby a predetermined quantity of heavy oil may be discharged irrespective of the position in which the can is used. Patent 1704573. William G. Matthews.

VENTILATOR—So constructed that it may be readily attached to or detached from the inside of an ordinary window sash without in any way marring the sash frame or molding strip. Patent 1704578. Fred J. Rennert.

METHOD OF AND APPARATUS FOR CONSERVING COCOONS OF SILK-PRODUCING INSECTS—Comprising a chamber for subjecting the cocoons to chilled air, thus arresting the development of chrysalide to moth form, yet preserving the silk providing filament in an unbroken perfect state. Patent 170972. Glenn D. Hurst.

SAFETY RAZOR—Comprising a specially formed blade holder, intended for use with well known single-edge razor blades, but which prevents the accumulation of lather and cut hair, and facilitates shaving operations. Patent 1074591. Edwin L. Connor.

COMPACT HOLDER—Wherein a retractile holding element is provided normally acting to substantially lock the compact in place, but permit the release thereof at any time. Patent 1704616. William G. Kendall.

CONTAINER STOPPER—In the form of a disk of balsa wood, which will not affect the color or flavor of the liquid stoppered, for use with metal crowns or caps. Patent 1705445. Kurt R. Gitterman.

COFFEE-MAKING APPARATUS—In which the coffee liquid contained in the coffee receptacle may be caused to siphon from the receptacle through coffee grounds by merely moving a single valve. Patent 1704809. George P. Petropulos.

WINDOW SCREEN—A frame, part of which is permanently secured, and part disengageably connected to a window frame, and means associated therewith for maintaining a strip of netting under continuous tension. Patent 1705442. Franklin Dominick.

CURTAIN STRETCHER—Including a rectangular self-supporting framework which may be conveniently set up, accurately squared, and readily adjusted to accommodate curtains of various widths and lengths. Patent 1706283. Charles M. Flink.

PIPE - CLOSURE - FORMING DEVICE — Which may be quickly formed at the end of a pipe without the necessity of welding, and will withstand any ordinary pressure to which the pipe would be subjected. Patent 1705864. Percy Jackson.

PILING—A hollow pile through which a refrigerant may be circulated to freeze wet or infirm earth in which the pile is embedded whereby it may be better worked. Patent 1704577. Edmund S. Pomykala.

PLATE-GLASS HOLDER—So constructed that they may be readily assembled for holding panels of glass in place on the top of and along the marginal edges of a display counter. Patent 1706345. Charles Bleakley.

METAL-MOLDING APPARATUS—A flask which is very compact and requires a relatively small amount of sand in casting iron sash weights or similar articles, especially effective where quantity production is desired. Patent 1706305. Charles H. Lyne.

BAG HOLDER AND DISPLAY RACK—Composed of a plurality of units of different sizes adapted to be arranged in superimposed relation, with means for readily selecting the bag required by sliding movement. Patent 1706307. Theodore P. McCarthy.

COMBINATION SCRAPER, BLADE SHARPENER AND CORN CUTTER—Wherein a double edged cutting blade may be differently adjusted, so that both edges may be utilized, or only one as preferred, or may be positioned for sharpening. Patent 1707154. Abraham Zilbersher.

Hardware and Tools

MODELING TOOL—Which is more or less pointed and flexible, for molding flowers or other articles, whereby a pair of prongs will produce grooves or beads by varying the tension on the tool. Patent 1703785. Annette Shuttleworth.

BOILER-MAKER'S TOOL—Which is adapted for use with pneumatic hammers or like power devices to simultaneously flare and set on the end of a flue tube in a locomotive engine. Patent 1707124. Harry A. Lacerda.

AUTOMATIC FEED FOR PORTABLE DRILLS—Designed to permit of its operation in inaccessible places and where the ordinary form of ratchet drill could not be used due to the inability to rock the operating handle. Patent 1705384. Andrew J. Wikander.

NAIL-STRIPPING DEVICE—Adapted to be worn in position for use, without interference with the workman's movement, and holding a mass of nails for convenient removal, one or more at a time as desired. Patent 1705435. Barton O. Wooster.

FAUCET—In which a rubber valve is moved toward or away from the valve seat, novel means being provided for rigidly holding the valve against lateral movement, thus increasing its life. Patent 1705404. Samuel L. Hedberg.

HAND-OPERATED LATCH NEEDLE—Comprising a handle, a latch needle, and spring means adapted to be flexed for guiding and limiting the movement of the needle when the latter is projected through a fabric. Patent 1704790. Barton E. Cook.

TWISTING DEVICE—In which the body portion comprises two sections hingedly secured together, and in which the handles are secured to one of the sections, thereby providing a device which may be readily opened with one hand, and is convenient to handle when working in inconvenient places. The inventor has been granted two patents, 1705369 and 1705411. William J. Leach.

UNION COUPLING—For detachably connecting adjacent ends of pipes so that a fluid tight connection may be established, without any necessity for compressible packing between the separable members. Patent 1707087. Wilber R. Little.

Heating and Lighting

GRATE—Having a plurality of parallel webs spaced apart so that ashes may drop between, said webs providing a plurality of points of support for independent removable fuel-supporting elements. Patent 1703748. Herbert F. Porter.

HEAT CONTROL FOR COOKING DEVICES—Automatically operable to modify heat, by reducing the temperature at a predetermined time after the material to be cooked attains a certain temperature, and subsequently discontinuing the heat. Patent 1702480. John F. Newsom.

DEHYDRATING APPARATUS—Having a curing compartment at the bottom, and drying compartment above, and open to the air in the housing, the greater portion of heat being directed to the curing chamber. Patent 1704912. Martha E. Bussler.

WATER HEATER—In which the heating coils can be readily applied or removed without the necessity of uncoupling the steam supply pipes, and when applied will provide a steam-tight connection. Patent 1705382. John A. Tyler.

ILLUMINATING DEVICE—Having a plurality of rows of lamps arranged on a rotatable table, disposed in stepped relation, so that the illumination will cover a considerable area without concentrating on a particular spot. Patent 1707171. Thomas O. Moore.

Machines and Mechanical Devices

COTTON GIN—In the form of an attachment for air blast cotton gins, which will co-operate with the air nozzle to clear the same of all foreign matter, throughout the ginning operations. Patent 1703002. Joseph L. Hart.

WELL BARREL—So constructed that it will operate as a gas trap permitting fluid to run in and prevent gas from working on the valves, and will separate sand from the oil. Patent 1703036. Charles Heath.

SMOKEHOUSE—Having electrically operated means for imparting rotary motion to a frame or basket supporting meat to be smoked, the circuit being controlled only by securely closing the doors. Patent 1704650. Leo Brand.

MOTORIZED HANDSAW—Of simple and practical construction, durable and efficient in use, yet relatively of light weight, may be manually manipulated and operated by steam or other motive fluid. Patent 1704641. Frank L. Weed.

VALVE CONSTRUCTION CONTROLLING THE OPERATION OF GREASE DISPENSERS—Having a piston adapted to be operated by compressed air, and in which an exhaust valve and an inlet valve for the compressed air are automatically controlled. Patent 1704596. George Emmert.

AUTOMATIC CONTROL MECHANISM FOR DRILLING RIGS—Readily applied to standard drilling rigs and operating automatically to discontinue operation of the prime mover, whether steam or gas engine, immediately upon the belt becoming untrained from the band wheel. Patent 1704464. Floyd M. Detwiler.

WIRE-WINDING MACHINE—A hand operated machine, with automatic feeding and tensioning for spirally applying wire to a spool, particularly adapted for winding tuning coils, as used in radio apparatus. Patent 1704166. Vincent Calabrese.

PUTTY MIXING AND CONDITIONING MACHINE—Which thoroughly kneads and mixes the putty so as to properly condition the same, and dispenses the putty in desired cut-off quantities. Patent 1706291. Frank F. Hayes.

DISPENSING CABINET—Of the self-serving type, delivering a single package, such as cigarettes, and actuating a signal to attract the clerk's attention so that he may remove the purchase price. Patent 1706298. Edwin B. Jelks and Joseph W. Harner.

ROTARY DIE PRESS—Especially designed for cutting or embossing heavy stock, such as cardboard, in which one of the die supports is reciprocatory, and the stock support is of the multifaced rotary type. Patent 1706319. Morris Oxenhandler.

METHOD AND MEANS FOR PITTING FRUIT—Such as prunes, peaches, apricots, dates or the like, by the use of compressed air or steam, and causing the pulp and pits to be separately directed to suitable receptacles. Patent 1706322. John Ramslie.

CONVEYING AND MEASURING APPARATUS—Designed to effect a uniform feed for granular or pulverulent material, including a screw and housing therefor, working without danger of the material flooding or accelerating its rate of feed. Patent 1706292. Arthur W. Hayman.

STAPLING MACHINE—Of the portable type, which includes means for cutting staple blanks from a strip of material, and driving the formed staples by means of a spring-actuated trip plunger. Patent 1705819. Alexander Z. Kruse.

APPARATUS FOR FASTENING PAIL COVERS—Comprising a supporting base and a movable mounting for the crimping mechanism, which permits swinging the mechanism, to one side, before placing the pail upon the base. Patent 1706299. Smith M. Johnson.

STAMPING MACHINE—A stencilling device in the form of a cylinder, in which a plurality of pads are associated, adapted to be revolved over a roadbed for printing indicia readable by tourists. Patent 1707149. Henry G. Stamper.

CONVEYER CHAIN—Particularly adapted for use on automatic or semi-automatic machines, the article-supporting members being connected to a chain in such manner as to maintain the centers properly spaced. Patent 1707088. Frank J. Lynch.

ENVELOPE-FEEDING APPARATUS FOR TYPEWRITERS—Which will accommodate any ordinary sized envelope, and will feed the envelopes one at a time to the typewriter, without the operator handling them until the addressing operation is completed. Patent 1707080. Harold L. Dyer.

HYDRAULIC WASHING MACHINE—Which may be connected by a hose to a house faucet for operating the machine and cleansing the clothes, the operating parts are protected against the clothing becoming entangled therewith. Patent 1707083. Harley A. W. Howdott.

ATTACHMENT FOR GRAIN PURIFIERS—A suction device which may be readily installed in connection with various forms and sizes of grain purifiers, for withdrawing specks and other forms of inpurity from the grain. Patent 1706800. Thomas A. McWilliams, Omer C. Parman and Albert R. Overall.

MOLD—More particularly for casting double walled pistons, easily assembled and disassembled and from which the cast piston may be readily removed. Patent 1705905. Lewis R. Davis.

Medical Devices

EYE-EXERCISING APPARATUS—Designed to continuously move a plurality of objects toward the eyes of the patient, followed by a disappearing movement so that the eye muscles will be subjected to exercising motions. Patent 1702700. Earl L. Martin.

MANDREL—Which embodies means for positively clamping the mandrel in the clutch, thus facilitating the dentist's work, insuring the even running of the disk, and eliminating injury to the patient. Patent 1705440. Thomas D. Craig.

Musical Devices

VALVE—For wind instruments, particularly horns, the construction being such that co-operation of several valves may be obtained whereby they may be applied to a horn or other musical instruments. Patent 1703411. Theodore A. Steinmetz.

COMBINED MAGNET AND VALVE—A relatively small instrument combining a valve and an electro-magnet, for controlling the passage of air to the pipes of a pipe organ, disassembly for repair is readily accomplished. Patent 1703771. August A. Klann.

BRIDLE STRAP FOR PIANO ACTIONS—Which embodies in combination with a tape, a clip adapted to embrace the catcher head and its shank with such security as to prevent its accidental disengagement. Patent 1703298. Hiram E. Chute.

Plumbing and Fixtures

TOILET-FIXTURE SUPPORT—For sinks, washstands, water closets, etc., which may be quickly enstalled and embodies a support for the flush valve sleeve carried and supported directly from the wall plate. Patent 1706285. Richard T. Frye.

Railways and Their Accessories

EMERGENCY CHECK VALVE — For automatically closing a valve in the main turret of a locomotive, in the event of a wreck, to prevent steam escaping and the scalding of the engine crew. Patent 1703801. Lewis I. Ve Verka.

TRAIN SIGNAL—Which affords facilities for causing a signal to be actuated in the engine cab whereby the engineer will be apprised of an obstruction in advance of the engine. Patent 1703055. Walter Bourg.

Pertaining to Recreation

GOLF INSTRUCTING APPARATUS—In the form of a belt, having mechanism therein for momentarily restraining the pivoting of the body relative to the arms in the downward swing, thus preventing a tendency to mistime the ball. Patent 1703375. Andrew C. Volk.

PUNCHING BAG—With a rocking support and a compressible spring, whereby a lateral movement will cause a compression so that when the bag is released it will automatically return to its original position. Patent 1703012. Denis McNamara.

FISHING TACKLE—Constructed of strands of spring wire fashioned to provide arms that project at right angles for supporting hooks, so that they will not become tangled with the main line. Patent 1702417. Alexander T. Sandbo.

GAME APPARATUS—Comprising a gameboard and a pair of chance-controlled longitudinally movable tokens, one being rotatable about its axis, and means operating independently to control the movement of the tokens. Patent 1704619. Harvey C. Markman.

SWING—Of simple construction and portable nature, may be easily assembled, and will provide a rigidly interlocking frame of the "knock-down" type, without the use of bolts or other fastenings. Patent 1707167. Aud R. Marshall.

Pertaining to Vehicles

TIRE - PUMP - CONNECTING DEVICE—For connecting an air hose with a tire valve, whereby the connection may be established in a minimum time without the use of tools and will be firm. Patent 1702970. Fred I. Jaden.

VEHICLE ROOF—Capable of being moved to open position so that a substantially unobstructed view may be obtained through the vehicle tops, yet can be easily closed and effectively sealed to prevent leakage. Patent 1703395. Herman House.

AUTOMOBILE CLUTCH - OPERATING MECHANISM—Whereby great power is accomplished through a minimum of energy applied to the transforming of a partial rotary movement into a longitudinal movement, thereby preventing stripping of the gears in shifting. Patent 1704602. Emmet T. Harney.

SIGNAL DEVICE FOR AUTOMOBILES—Having mechanical means, actuated by the engine, for oscillating a warning signal so indicating in which direction the automobile is to turn, and for illuminating the license plate. Patent 1703957. George H. Sautier.

TIRE-RIM-CONTRACTING DEVICE—Which will hold the rim in contracted condition while the tire is being removed and replaced, and until released to return to its normal condition. Patent 1700719. Samuel H. Savage.

ACCELERATOR—An attachment encluding a base and a pedal rockably adapted to engage the accelerating means of an automobile; may be easily emplaced in the car by the owner. Patent 1700643. Carol Nordell.

WEATHER STRIP—Adapted for use on automobiles, windows, having substantially semi-frictionless portions, so as to allow the glass to slide reasonably free, and a resilient portion which tends to hold the glass firmly, and reduces the tendency of rattle or vibration. The inventor has been granted two patents, 1704997 and 1704998. Arthur H. Atxenhoffer.

AUTOMOBILE LOCK—For use in conjunction with a driven part of the motor or engine to prevent their being operated, and the car stolen by an unscrupulous person. Patent 1706352. Justin de Serguirant.

QUICK-DETACHABLE APPLIANCE—Which may be easily applied to a threaded tire valve stem extending through a bore in the rim of a vehicle wheel, to effectively hold the stem against withdrawal. Patent 1706317. George W. Oakes.

TRUCK TANK FOR LIQUIDS—Wherein a number of independent containers are provided in a single tank and associated with means whereby the contents of the various containers may be heated. Patent 1705649. Carlyle H. Scott.

LUBRICATOR INDICATOR—Wherein oil from the crank case of a motor vehicle can be elevated, by means of a pump, to a sight glass, and a specimen displayed for determining the condition. Patent 1706001. Philip Shapiro.

DECORATIVE WREATH FOR AUTOMOBILE HEADLIGHTS—Which may be conveniently attached to or removed from the usual automobile headlight casing, and when viewed from the front will conceal the casing, but leave the lens exposed. Patent 1707127. Burns H. Marshall.

SANDING MACHINE—Which will normally be inactive, but will provide a convenient means for allowing the driver to spread sand in front of the wheels to prevent skidding on slippery roads. Patent 1705878. John Robbins.

SMOKER'S ARTICLE—Adapted for supporting a package of matches, and cigarettes or cigars adjacent the steering wheel, and an accessory for extinguishing the cigars or cigarettes preparatory to discarding them. Patent 1705898. Kingsley W. Cannon and Frederick G. E. Lange.

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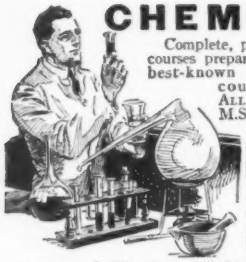

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